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The Pennsylvania State College Bulletin

GRADUATE SCHOOL

ANNOUNCEMENT



1953

1954

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STATE COLLEGE, PENNSYLVANIA

The Pennsylvania State College Bulletin

GRADUATE SCHOOL

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COLLEGE

SPRING SEMESTER 1953

JANUARY 1953

28-31 Wednesday to Saturday—Spring Semester Registration and Orientation

FEBRUARY

2 Monday—Spring Semester Classes Begin 8 a.m.

APRIL

1 Wednesday—Spring Recess Begins 11:50 a.m.

8 Wednesday—Spring Recess Ends 1:10 p.m.

MAY

23 Saturday—Spring Semester Classes End 11:50 a.m.

23 Saturday—Spring Semester Examinations Begin 1:30 p.m.

30 Saturday—Memorial Day Recess

31 Sunday—Baccalaureate Day, Class Day

JUNE

3 Wednesday—Spring Semester Ends 12:30 p.m.

4 Thursday—Commencement Day

SUMMER SESSIONS 1953

JUNE 1953

9 Tuesday—Registration for Inter-Session in a.m.

9 Tuesday—Inter-Session Classes Begin 1:20 p.m.

26 Friday—Inter-Session Ends 5:50 p.m.

29 Monday—Registration for Main Summer Session

30 Tuesday—Main Summer Session Classes Begin 8 a.m.

JULY

4 Saturday—Independence Day Recess

AUGUST

7 Friday—Main Summer Session Ends 5:50 p.m.

8 Saturday—Main Summer Session Graduation Exercises

10 Monday—Registration for Post-Session in a.m.

10 Monday—Post-Session Classes Begin 1:20 p.m.

28 Friday—Post-Session Ends 5:50 p.m.

CALENDAR

**FALL SEMESTER 1953*

SEPTEMBER 1953

- 13 Sunday—Orientation Week Begins
- 16-19 Wednesday to Saturday—Fall Semester Registration
- 21 Monday—Fall Semester Classes Begin 8 a.m.
- 30 Wednesday—Convocation of the Graduate School

NOVEMBER

- 25 Wednesday—Thanksgiving Recess Begins 11:50 a.m.
- 30 Monday—Thanksgiving Recess Ends 8 a.m.

DECEMBER

- 19 Saturday—Christmas Recess Begins 11:50 a.m.

JANUARY 1954

- 4 Monday—Christmas Recess Ends 8 a.m.
- 16 Saturday—Fall Semester Classes End 11:50 a.m.
- 16 Saturday—Fall Semester Examinations Begin 1:30 p.m.
- 27 Wednesday—Fall Semester Ends 12:30 p.m.
- 27 Wednesday—Fall Semester Graduation Exercises

SPRING SEMESTER 1954

FEBRUARY 1954

- 3-6 Wednesday to Saturday—Spring Semester Registration and Orientation
- 8 Monday—Spring Semester Classes Begin 8 a.m.

APRIL

- 14 Wednesday—Spring Recess Begins 11:50 a.m.
- 21 Wednesday—Spring Recess Ends 1:10 p.m.

MAY

- 29 Saturday—Spring Semester Classes End 11:50 a.m.
- 29 Saturday—Spring Semester Examination Begin 1:30 p.m.

JUNE

- 6 Sunday—Baccalaureate Day, Class Day
- 7 Monday—Spring Semester Ends 5 p.m.
- 7 Monday—Commencement Day

* Fall Semester—One football Saturday half holiday by student selection.

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Professor of Psychology
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ROY C. BUCK, M.S., Ph.D.	<i>Assistant Professor of Rural Sociology</i>
HOWARD LEON CARNAHAN, M.S., Ph.D.	<i>Assistant Professor of Agronomy</i>
ELTON STEWART CARTER, M.A., Ph.D.	<i>Assistant Professor of Speech</i>
GEORGE E. CEIGA, B.Mus.	<i>Assistant Professor of Music</i>
RALPH W. CONDEE, A.M., Ph.D.	<i>Assistant Professor of English Literature</i>
WILLIAM CRAIG, Ph.D.	<i>Assistant Professor of Mathematics</i>
GILBERT LEROY CROSSLEY, E.E.	<i>Assistant Professor of Electrical Engineering</i>
HOWARD CUTLER, M.A., Ph.D.	<i>Assistant Professor of Economics</i>
HOLLE G. DEBOER, M.A.	<i>Assistant Professor of Public Speaking</i>
NORMAN C. DENO, M.S., Ph.D.	<i>Assistant Professor of Chemistry</i>
JOHN A. DENOVO, M.A., Ph.D.	<i>Assistant Professor of History</i>
M. ELNER DENSON, M.S., Ph.D.	<i>Assistant Professor of Geophysics</i>
FELIX DU BREUIL, M.S., Ph.D.	<i>Assistant Professor of Mining Engineering</i>
CHARLES LEONARD FERGUS, M.A., Ph.D.	<i>Assistant Professor of Botany</i>
ILINE FIFE, M.A., Ph.D.	<i>Assistant Professor of Speech</i>
HENRY R. FORTMANN, M.S., Ph.D.	<i>Assistant Professor of Agronomy</i>
LAWRENCE E. FOURAKER, M.S., Ph.D.	<i>Assistant Professor of Economics</i>
JOHN C. FREY, M.S., Ph.D.	<i>Assistant Professor of Land Economics</i>
JAMES J. FRITZ, M.S., Ph.D.	<i>Assistant Professor of Chemistry</i>
LEON GORLOW, A.M., Ph.D.	<i>Assistant Professor of Psychology</i>
JOSEPH H. GRAHAM, Ph.D.	<i>Assistant Professor of Plant Pathology</i>
PHYLLIS RICE GRIESS, M.A., Ph.D.	<i>Assistant Professor of Geography</i>
GEORGE MCRUER GUTHRIE, Ph.D.	<i>Assistant Professor of Psychology</i>
FREDERICK L. GWYNN, A.M., Ph.D.	<i>Assistant Professor of English Literature</i>
OSCAR A. HAAC, M.A., D.U.P., Ph.D.	<i>Assistant Professor of Romance Languages</i>
CHARLES G. HAAS, JR., S.M., Ph.D.	<i>Assistant Professor of Chemistry</i>
EDGAR BREWER HALE, M.S., Ph.D.	<i>Assistant Professor of Poultry Husbandry and Psychology Research</i>
JOHN F. HALL, M.A., Ph.D.	<i>Assistant Professor of Psychology</i>
CHARLES L. HOSLER, JR., M.S., Ph.D.	<i>Assistant Professor of Meteorology</i>
L. AILEEN HOSTINSKY, M.A., Ph.D.	<i>Assistant Professor of Mathematics</i>
LYMAN C. HUNT, M.A., D.Ed.	<i>Assistant Professor of Education</i>
EARL M. KESLER, M.S., Ph.D.	<i>Assistant Professor of Dairy Husbandry</i>
JOHN R. KINNEY, M.S., Ph.D.	<i>Assistant Professor of Mathematics</i>
LEON R. KNEEBONE, Ph.D.	<i>Assistant Professor of Botany</i>
JOSEPH THADDEUS LAW, M.A.	<i>Assistant Professor of Political Science</i>
KENNETH B. LAWRENCE, M.S.	<i>Assistant Professor of Mechanical Engineering</i>
NEIL A. McNALL, M.A., Ph.D.	<i>Assistant Professor of History</i>
MORRIS MENDELSON, Ph.D.	<i>Assistant Professor of Economics</i>
JOHN P. MILLER, Ph.D.	<i>Assistant Professor of Geology</i>
GERALD M. MOSER, D.U.P.	<i>Assistant Professor of Romance Language</i>
ROBERT K. MURRAY, M.A., Ph.D.	<i>Assistant Professor of History</i>
VERNON W. MYERS, M.A., Ph.D.	<i>Assistant Professor of Physics</i>
AMOS EARL NEYHART, M.S.	<i>Administrative Head, Institute of Public Safety</i>
PAUL F. NORTON, M.F.A., Ph.D.	<i>Assistant Professor of Fine Arts</i>

THE PENNSYLVANIA STATE COLLEGE

EDWIN P. NYE, M.S.	<i>Assistant Professor of Mechanical Engineering</i>
WILLIAM C. PADDOCK, Ph.D.	<i>Assistant Professor of Plant Pathology</i>
LAWRENCE PARK, M.A., D.Ed.	<i>Assistant Professor of Elementary Education</i>
JEROME K. PASTO, M.S., Ph.D.	<i>Assistant Professor of Farm Management</i>
ROY P. PENNINGTON, Ph.D.	<i>Assistant Professor of Soil Technology</i>
RAYMOND T. PIERCE, Jr., Ph.D.	<i>Assistant Professor of Agricultural and Biological Chemistry</i>
THEODORE STEPHEN POLANSKY, M.S., Ph.D.	<i>Assistant Professor of Fuel Technology</i>
EDWARD W. PROCTOR, A.M., Ph.D.	<i>Assistant Professor of Economics</i>
MARGARET C. RAABE, M.S.	<i>Assistant Professor of Clinical Speech and Speech Education</i>
ROBERT R. REED, JR., M.A., Ph.D.	<i>Assistant Professor of English Composition</i>
NEAL RIEMER, M.A., Ph.D.	<i>Assistant Professor of Political Science</i>
GUY RINDONE, M.S., Ph.D.	<i>Assistant Professor of Ceramics</i>
C. MARSHALL RITTER, M.S., Ph.D.	<i>Assistant Professor of Pomology</i>
ALLAN RODGERS, M.A., Ph.D.	<i>Assistant Professor of Geography</i>
LÉON S. ROUDIEZ, M.A., Ph.D.	<i>Assistant Professor of Romance Languages</i>
RUSTUM ROY, M.S., Ph.D.	<i>Assistant Professor of Geochemistry</i>
CHARLES W. RUTSCHKY, Ph.D.	<i>Assistant Professor of Entomology</i>
DONALD P. SATCHELL, M.S., Ph.D.	<i>Assistant Professor of Soil Technology</i>
JOHN MOREY SCHEMPF, Ph.D.	<i>Assistant Professor of Chemistry</i>
ROBERT SCHOLTEN, M.S., Ph.D.	<i>Assistant Professor of Petroleum Geology</i>
PAUL E. SHIELDS, M.S., E.E.	<i>Assistant Professor of Electrical Engineering</i>
BRUCE M. SIEGENTHALER, M.A., Ph.D.	<i>Assistant Professor of Clinical Speech</i>
RUTH C. SILVA, M.A., Ph.D.	<i>Assistant Professor of Political Science</i>
PHILIP S. SKELL, M.A., Ph.D.	<i>Assistant Professor of Chemistry</i>
CYRIL B. SMITH, M.Sc., Ph.D.	<i>Assistant Professor of Plant Nutrition</i>
WILLIAM SPACKMAN, JR., M.S., Ph.D.	<i>Assistant Professor of Paleobotany</i>
WERNER F. STRIEDIECK, A.M., Ph.D.	<i>Assistant Professor of German</i>
ROBERT W. TAFT, JR., M.S., Ph.D.	<i>Assistant Professor of Chemistry</i>
JACK R. TESSMAN, M.A., Ph.D.	<i>Assistant Professor of Physics</i>
DONALD LAURENCE THOMSEN, Ph.D.	<i>Assistant Professor of Mathematics</i>
RALPH FRANCIS TRAMBARULO, Ph.D.	<i>Assistant Professor of Physics</i>
LOREN D. TUKEY, M.S., Ph.D.	<i>Assistant Professor of Pomology</i>
DAVID VAN METER, M.S.	<i>Assistant Professor of Electrical Engineering</i>
RICHARD W. VAN NORMAN, Ph.D.	<i>Assistant Professor of Botany</i>
WALTER H. WALTERS, Ph.M., M.F.A., Ph.D.	<i>Assistant Professor of Dramatics</i>
JOHN N. WARFIELD, M.S., Ph.D.	<i>Assistant Professor of Electrical Engineering</i>
THOMAS WARTIK, Ph.D.	<i>Assistant Professor of Chemistry</i>
GEORGE HARRISON WATROUS, JR., M.S., Ph.D.	<i>Assistant Professor of Dairy Husbandry</i>
ALFRED FREDERICK WOELFEL, M.S.	<i>Assistant Professor of Electrical Engineering</i>
JAMES EVERETTE WRIGHT, Ph.D.	<i>Assistant Professor of Genetics</i>
KELLY YEATON, M.A.	<i>Assistant Professor of Dramatics</i>
VICTOR F. ZACKAY, M.S., Ph.D.	<i>Assistant Professor of Metallurgy</i>
C. COURSON ZELIFF, M.S., Ph.D.	<i>Assistant Professor of Zoology</i>
LEONARD N. ZIMMERMAN, M.S., Ph.D.	<i>Assistant Professor of Bacteriology</i>
HARRY DAVID ZOOK, M.S., Ph.D.	<i>Assistant Professor of Chemistry</i>

INSTRUCTORS

DAVID C. EKEY, M.Sc.	<i>Instructor in Industrial Engineering</i>
JAMES W. SHIGLEY, M.S., Ph.D.	<i>Instructor in Agricultural and Biological Chemistry</i>

THE GRADUATE SCHOOL

GRADUATE WORK at The Pennsylvania State College was first offered in 1862 when two graduate students were in residence. It was given more formal recognition in 1864 by the establishment of a "Course for Graduates" designed for students who, after receiving the degree of Bachelor of Scientific Agriculture, wished to do advanced work leading to the degree of Master of Scientific Agriculture. For some time there were few graduate students, and graduate instruction was relatively unorganized. Later a committee of the College Senate was given the responsibility of establishing standards and regulations governing graduate work and the granting of advanced degrees. The Graduate School was organized in 1922. Until this time only master's degrees and certain technical degrees had been conferred. In 1924, upon recommendation of the Graduate School, the Board of Trustees authorized the granting of the degree of Doctor of Philosophy. Still later other degrees were approved.

The faculty of the Graduate School consists of the President and certain other general administrative officers of the College, the Deans, the College Examiner, the Librarian, the heads of departments, and those members of the instructional staff who have been authorized by the proper agencies of the Graduate School to offer graduate courses and supervise research leading to theses and dissertations. It controls all academic matters pertaining to the Graduate School, subject to review by the College Senate.

The graduate faculty numbers approximately 500 members. Graduate student enrollment in 1951-52 was about 1300 per semester. During the summer sessions the graduate enrollment increased to approximately 2000. The number of advanced degrees conferred in 1951-52 was 729, of which 113 were doctor's degrees.

Applicants for admission to the Graduate School should understand that graduate work is not an extension of undergraduate work. It operates at a definitely higher level, demands scholarship of a high order, and emphasizes research and creativity. It involves a minimum of formal requirements and regulations and a maximum of student initiative and responsibility.

Students are expected to assume full responsibility for knowing the regulations and pertinent procedures of the Graduate School (as set forth in the *Graduate School Announcement* and in the *Manual for Graduate Students*) and for meeting the standards and requirements expressed by these regulations. The *Manual*, which is available to students after they have been admitted, sets forth in more detail the general regulations outlined in the *Announcement* and furnishes other information about the Graduate School which is useful to graduate students. Students should secure a copy of this manual from the Dean's Office as soon as possible after admission.

PROCEDURES AND REGULATIONS

ADMISSION—A student does not become a graduate student merely by enrolling for advanced courses after having received a baccalaureate degree. Formal admission to the Graduate School is required. Credits earned before admission cannot be applied to meet degree requirements at a later date even though admission may have been granted in the meantime.

For admission to the Graduate School an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit

THE GRADUATE SCHOOL

conditions substantially equivalent to those required by The Pennsylvania State College. He must have maintained during his junior and senior years a minimum grade point average equivalent to 1.5 on The Pennsylvania State College grading scale. Finally, he must ordinarily have completed in a satisfactory manner a certain minimum of course work in designated areas, the specific courses and amount of required work depending upon the field of advanced study which the student proposes to enter.

The minimum average of 1.5 during the last two undergraduate years is a general requirement of the Graduate School. Individual departments may require a higher average for admission to advanced study in their fields. Prospective students are encouraged to write directly to the head of any department concerning graduate work in that specific field.

A student applying for admission after having attended another graduate school where a substantial amount of credit has been earned, or a student whose career subsequent to graduation has been characterized by unusual attainments in fields having a bearing on his graduate qualifications, will be rated by a combination of the records submitted.

Admission to the Graduate School is granted by the Dean of Admissions after approval of the application for admission by the department in which the student plans to do his major work. Blanks to be used in making formal application for admission can be obtained from the Dean of Admissions. The application blanks give instructions and explain in detail the procedures of admission. With his application each student should present the names of two persons to whom departments may write, and who are well qualified to evaluate his abilities for graduate work in the field of his choice.

An applicant for admission should provide complete credentials, in duplicate, sent directly from other institutions to the Dean of Admissions well in advance of the date when the student expects to enroll. If the applicant has attended more than one institution, two official transcripts of the work covered at each institution are required. This applies to the complete academic record, both undergraduate and graduate.

If credentials are not sent in advance or are not available at the time of registration, this does not necessarily mean that the application for admission will be refused. However, it does mean that the applicant will be admitted only on a provisional basis pending receipt of his official credentials. The provisional admission will be subject to cancellation if the credentials, on their arrival, do not meet all the requirements for admission to the Graduate School. Also, certification of any scheduled credits while the applicant is holding provisional admission will be withheld until receipt of his official credentials makes possible the applicant's permanent admission to the Graduate School.

Formal readmission is not required year by year, nor after one or more semesters of absence from the campus. However, a student who has earned a master's degree should not register for further work until his academic record and personal qualifications have been reviewed critically by the department of his major interest and he has been encouraged to become a candidate for the doctorate or has the department's approval for proceeding for a short time as a general graduate student.

The President of the College, on recommendation of the Dean of the Graduate School, will welcome doctors of philosophy of The Pennsylvania State College, as well as those of other accredited colleges and universities, as guests of the College, with the privilege of attending seminars and courses and of carrying on research in laboratories and libraries. There will be no charge except for laboratory ex-

penses. Arrangements should be made in advance with the Dean of the Graduate School.

CLASSIFICATION—At the time of admission all students are classified either as regular graduate students or as general graduate students. Regardless of classification, all students, upon admission to the Graduate School, must register through the Graduate Dean's office for all work taken, whether or not that work is to be credited toward the requirements for a degree.

Regular Graduate Students—This group includes those persons who plan to become candidates for degrees at The Pennsylvania State College and who have been formally admitted by the Dean of Admissions for advanced study in a particular department. The program of study is developed under the guidance of the department head or his representative. Graduate students who plan to be candidates for advanced degrees should enroll as regular graduate students.

It should be emphasized that a student is not a regular graduate student unless he has been officially admitted to that status. Regular attendance in the Graduate School or personal plans for future degree candidacy do not in themselves grant the status or privileges of a regular graduate student.

Regular graduate students who have passed candidacy evaluations are classified as doctoral candidates and may register for doctoral dissertation credit.

General Graduate Students—Applicants who meet all requirements for admission to the Graduate School, but who do not wish to work for an advanced degree at this institution, may arrange for a program of work as general graduate students. This classification includes those who plan to transfer credits to another institution and those who plan to follow a special program of study for the fulfillment of requirements other than those for advanced degrees. The program of study is developed under the guidance of an adviser appointed by the Dean of the Graduate School.

The status and standing of a general graduate student will be reviewed by the Dean each time he reregisters. He may not remain a general graduate student longer than one semester (or summer sessions totaling 12 weeks) except with the permission of the Dean, and for definite and good reasons.

When a general graduate student wishes to become a regular graduate student, i.e., to work for an advanced degree at this institution, he should make application for change of status. His undergraduate record will then be re-evaluated to determine to what extent he is prepared to undertake graduate work for a degree in the major field of his choice. He should understand that he may thereafter apply toward degree requirements only those credits earned as a general graduate student which fit logically into an integrated degree program. There is no upper limit on the number of credits that may be so applied; neither is there any assurance that any such credits may be applicable.

Special and Unclassified Students—Special and unclassified students are not graduate students, inasmuch as they have not been admitted to the Graduate School. Consequently they are not permitted to register for graduate courses (500 series). Special or unclassified students who are later admitted to the Graduate School may not then count toward degree requirements any credits whatsoever that have been earned by them while in the special student status.

REGISTRATION—Registration dates are given in the College Calendar, and a penalty fee is assessed for failure to register on the appointed days. In any case,

PROCEDURES AND REGULATIONS

registration must be completed within the first two weeks of a semester. The student is required to register for each semester and each summer session in which he proposes to do either course work or research, either on or off the campus.

For each registration the student, in consultation with his adviser, prepares a schedule of courses and research designed to fit his individual needs, which is then submitted to the Dean of the Graduate School for his approval. The registration process is then completed in the manner specified for all students at the College.

Under certain conditions credit may be earned by work done off the campus. Students contemplating such work should inquire of the Dean of the Graduate School about the plans and conditions. Such work must be scheduled *in advance* in the regular manner.

ACADEMIC LOAD—A full-time student is one who devotes "all" his time to studies and/or research, and very little, if any, time to work for financial compensation. The normal maximum full-time credit load is 15 credits per semester, or 1 credit per week in shorter terms such as summer sessions. Larger loads may be scheduled very rarely and only with the approval of the Dean of the Graduate School. Ordinarily students employed for more than a few hours per week may not register for 15 credits per semester, or 1 credit per week. A student must register for at least 12 credits in order to have the privileges of a full-time student.

The College takes the position that the facilities of the Graduate School should be made available only to students who can profit from their graduate school experience to a maximum extent. Therefore the Graduate School reserves the right to deny admission or registration to part-time students who (a) propose schedules of few credits which seem to reflect little real interest in graduate work or would not seem to require serious effort, or (b) wish to carry overloads of such proportions as to handicap them seriously in achieving maximum quality in their graduate work.

Part-time students who are graduate assistants or employees of the College are governed by the following load schedules:

ACADEMIC LOAD		SERVICE LOAD	
<i>Fraction of Full Load</i>	<i>Credits</i>	<i>Fraction of Full Load</i>	<i>Hours per Week</i>
4/5	12	1/4	10
2/3	10	1/2	20
1/2	8	3/4	30
2/5	6	4/4	40

The considerations leading to the establishment of this "protective" schedule of permitted loads for assistants and employees apply equally to part-time students employed off-campus.

AUDITING OF COURSES—Students who have demonstrated their ability to do superior work while carrying normal graduate programs (which are determined by their status as full-time students, or as part-time students employed on the campus or elsewhere) may, with the approval of the Dean, register for "audits" in addition to their normal credit loads. To secure such approval the student should present to the Dean written evidence that the instructor of the "audit" course will accept him as auditor, and that his adviser and the head of the department employing him (if he be employed) approve of the extra load.

ACADEMIC DEGREES

MASTER OF ARTS AND MASTER OF SCIENCE

These two degrees have similar requirements, the Master of Arts being conferred upon students in the liberal arts and the Master of Science upon those in science and technology.

ADMISSION—Adequate undergraduate preparation is required in the field in which the applicant expects to pursue advanced work. The specific courses and the total number of undergraduate credits required in various areas will be determined by the choice of field and can be ascertained from the Dean of Admissions. An applicant who meets the minimum grade point average but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A program for the master's degree requires a minimum of 30 credits and consists of one major and not more than two minor subjects. Except by permission of the Dean, one minor subject must be chosen in a field of study different from that of the major. The program requires the equivalent of at least one academic year (two semesters), and may be met by full-time residence, part-time work, attendance in the summer sessions, or by any combination of these. Many students find that adequate programs leading to the master's degree involve considerably more than 30 credits and require more than one year's work. Ten credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State College may, under certain conditions, be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven summers.

At least 12 credits earned in course work and a thesis equivalent to at least 6 credits must be devoted to the major subject. Not more than 12 credits may be offered in courses open to upper-class and graduate students (400 series). A student's program must be approved by his adviser and the Dean.

In addition to the above general requirements, major departments may set up specific course and subject-matter requirements for students working in their area.

The mere completion of a stated amount of work does not entitle a student to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS—Under the direction of the department in which the student's major subject is taken, he must prepare a thesis upon a suitable topic related to that subject. Under certain conditions a student may be permitted to complete the thesis in absentia. To obtain such permission he must make satisfactory arrangements in advance both with the major department and with the Dean.

For instructions concerning the form and the filing of typewritten copies of the thesis, see the *Manual for Graduate Students*.

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced by

DOCTOR OF PHILOSOPHY

(1) the satisfactory completion of a prescribed period of study and investigation, (2) the preparation of a dissertation involving independent research, and (3) successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State College in regular semesters. A minimum of three academic years of full-time graduate study and research, or their equivalent, is required for the attainment of a doctor's degree. The equivalent of two academic years may be secured by residence at another institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and dissertation requirements within the period of one academic year on this campus.

Students devoting only a portion of their time to their program will be credited on their residence requirements in proportion to the time actually spent in graduate study and research.

For regulations and procedures concerning off-campus research, see the *Manual for Graduate Students*.

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The program shall consist of such a combination of courses and research as is approved by the doctoral committee for each individual student, and includes a major and one or two minor subjects. Approximately two thirds of the total time is to be devoted to the major subject. A division of the remaining one third of the total time on the basis of two to one between the first and second minors is satisfactory.

The first year of graduate study leading to the doctor's degree may be substantially the same as that provided for the master's degree and may lead to that degree, although that is not necessary.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Philosophy must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of residence. A student transferring from another graduate school must take this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department. If the student passes the examination, and in the opinion of the graduate faculty of his major department is qualified to follow a doctoral program, he is admitted to candidacy.

After a student has been admitted to candidacy the Dean will appoint, upon recommendation of the head of the major department, his doctoral committee which will thereafter guide him in candidacy.

For the Doctor of Philosophy degree, candidates are required to have a reading knowledge of at least two foreign languages. German and French are the languages most often needed. Other languages may be presented instead of these if their choice is determined by scholarly and professional reasons. The choice of a language must be approved by the major department. If a language other than English, French, German, Italian, Spanish, or Russian is presented, it must be approved

also by the Dean of the Graduate School. A student may not present his mother tongue as one of the two languages required in candidacy. Candidates may present certification of having passed equivalent language examinations in other institutions in lieu of repeating the examinations. For further details, see the *Manual for Graduate Students*.

When a doctoral candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether he has adequate mastery of the subject matter to entitle him to proceed to the completion of a dissertation. The candidate must have satisfied the language requirements before taking this examination.

Doctoral candidates who have satisfied all other requirements for the degree will be scheduled, on recommendation of the doctoral committee, to take a final examination. In no case may the final examination be scheduled less than three months after the comprehensive examination. The final examination is oral, open to the public, related in large part to the dissertation, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

DISSERTATION—The ability to do independent research must be proved by the preparation of a dissertation on some topic related to the major subject. It should represent a contribution on some worth-while problem presented in a scholarly manner. The contents and conclusions of the dissertation must be defended at the time of the final examination.

The general subject of the dissertation must be determined at the time of admission to candidacy for the degree, and the completed dissertation, typewritten in triplicate, must be filed in the office of the Dean of the Graduate School not later than one week prior to the commencement at which the candidate expects to receive the degree.

For regulations concerning the form and the filing of the dissertation, see the *Manual for Graduate Students*.

PROFESSIONAL DEGREES

MASTER OF EDUCATION

In order to provide programs of advanced work which would utilize more fully the professional training and background of those holding bachelor's degrees from teachers colleges and schools of education, two professional degrees in education were established.

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership in educational work, and ability to solve concrete problems in at least one special field of educational activity.

ADMISSION—Applicants are required to have had at least 27 undergraduate credits in the field of education, including practice teaching, except that under certain circumstances this rule may be waived for students working for the Doctor of Education degree with a major in higher education. Applicants wishing to major in subject-matter fields will be expected to have in addition an adequate

undergraduate preparation in the field of specialization. The specific course requirements and the total number of undergraduate credits required in the various areas will be determined by the choice of field and can be ascertained from the Dean of Admissions. An applicant who meets the minimum grade point average for admission but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A minimum of 30 credits is required, of which 6 may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters) and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Ten credits earned in residence at another approved institution or in extension classes of The Pennsylvania State College may, under certain conditions, be offered as partial fulfillment of the requirements. All requirements must be met within six years, or a period spanning seven summers.

A minimum of 24 credits must be earned in graduate course work. The larger part of this work shall be in courses open only to graduate students, but the needs of the student shall be considered in arranging the best combination of courses (400 and 500 series) for the preparation of the candidate in his special field. The degree program must be approved by the student's adviser or advisory committee. When the major is in a specific field, the heads of the major and minor departments or fields (or their representatives), together with the supervisor of the thesis if there be one, constitute a special advisory committee which shall approve the study program. In practice the general guidance of a student is centered in an adviser from the major department who is familiar with the field in which the student is specializing.

When the student chooses a group major, his study program will be approved by a standing committee (or its representatives), which committee will foster the student's interests and stand in the same relation to him as does a department in the case of a student with a specific major. Such standing committees have been appointed in the broad fields of biological science, physical science, and social studies.

If a thesis is included in the program, it must be done under the direction of a supervisor representing either a major department or a standing committee supervising group majors. An amount of time equivalent to six credits may be devoted to research and the preparation of the thesis. Under certain conditions this may be carried out in part in absentia, particularly when requirements are met by summer session attendance. For regulations concerning the form and filing of theses, see the *Manual for Graduate Students*.

MAJOR FIELD—If a student looks forward to a career as a teacher, he may specialize in a specific subject-matter field (as English, mathematics, Latin, etc.), and that shall be regarded as the major field, and a majority of the work is to be taken there. The remainder of the time is to be devoted to a minor in the field of education.

Those desiring to prepare as supervisors and administrators may choose a major and a minor within the curriculums of education. The following fields are recommended: secondary school principal, elementary school principal, superintendent of schools, guidance counselor, vocational director, or supervisor. The student may choose one field of work for a major and another field for a minor. These majors

prepare for State certificates in those fields where special certificates are given. It is possible to arrange programs of study concentrated in other fields.

If a student wishes to work in a broader field, a group major such as social studies, physical science, or biological science may be chosen. In this case at least 24 credits are to be devoted to the group, and the remaining 6 credits to a minor in the field of education. It is expected that each student will choose one subject of the group as a field of primary interest, to which at least half of the 24 credits are to be devoted.

EXAMINATIONS—Candidates for the Master of Education degree must pass a final comprehensive examination. The examination will be designed to determine the ability of the candidate to apply the general as well as the special knowledge of his chosen field in practical situations.

Candidates majoring in education are required to take a departmental qualifying examination, comprehensive in scope, before completing the second half of their course requirements. This serves as a guide in outlining a program of study that will fit the individual needs of the student.

DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced (1) by the satisfactory completion of a prescribed period of study; (2) by the application of scientific principles in classroom teaching, in the supervision of instruction, or in administrative work; (3) by the preparation of a dissertation demonstrating ability to attack an educational problem with originality and independent thought; (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects; and (5) by recognized leadership in the profession of education.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State College. This requirement may be met by attendance at summer sessions, although there is no guarantee that it will be possible to do so in all cases. An equivalent of three years of graduate study is required as a minimum for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

The equivalent of two full years of work may be secured by residence at another institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and dissertation requirements within the period of one academic year on the campus. Credit for courses and research work done elsewhere can be used to meet degree requirements only if appropriate to the candidate's proposed program of study as determined by his doctoral committee.

One third of the requirements (equivalent to a 30-credit year) for the degree may be met by research work pursued away from the campus in the school systems of the State, or in other approved centers, provided (1) the plan be approved by the candidate's doctoral committee, (2) reports on the projects be made as directed by this committee, (3) not more than 6 credits be earned in an academic year,

DOCTOR OF EDUCATION

September to June, or 9 credits in a calendar year, and (4) the arrangement be approved by the Dean.

Work done off the campus which is to be credited toward a doctor's degree must be scheduled *in advance*, following regular registration procedure.

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a period of residence, a satisfactory dissertation, the passing of comprehensive examinations, and possession of the qualities of professional leadership. A program shall consist of such a combination of courses and individual study and research as is approved by the doctoral committee for each candidate.

The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement must be in the major field of study. The remainder shall be in one or two minors bearing some functional relation to the major and to the work the candidate is planning to do. These minors may be in academic subjects or in some phase of education or psychology other than the major. In the case of persons intending to continue in classroom teaching rather than in administrative or supervisory positions, a larger proportion of the work may be assigned to the academic fields in which the candidate is teaching, to whatever extent the doctoral committee may believe the background and the objectives of the particular candidate warrant. But every candidate for the degree of Doctor of Education must show through comprehensive examinations that he is familiar with current theories of education, that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject, that he is prepared to read understandingly and contribute to the technical professional literature in his field, and that he can criticize his own procedures in the light of historical trends and practices in this and other countries.

Command of the tools for a thorough study of the problems of education is necessary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Education must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of residence. A student transferring from another graduate school must take this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department.

Three of the important factors taken into consideration in passing judgment upon admission to candidacy are:

1. Previous scholastic record at this institution and other institutions attended.
2. Achievement in qualifying examinations.
3. Estimates of the student's personal and professional qualifications by the graduate faculty of the major department.

After a student has been admitted to candidacy, the Dean, upon recommendation

of the head of the major department, will appoint his doctoral committee which will thereafter guide him in candidacy.

When the candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether or not he is to be permitted to proceed to the completion of his dissertation. These examinations will be designed to test (1) the candidate's general scholastic preparation and professional background, and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

A candidate who has fulfilled all other requirements for the degree will, on recommendation of his doctoral committee, be permitted to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's doctoral committee and others appointed by the Dean of the Graduate School. The examination will be based largely upon the dissertation, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

For further details, see the *Manual for Graduate Students*.

DISSERTATION—Evidence of a high degree of scholarship and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written dissertation. The candidate must demonstrate capacity for independent thought as well as ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed dissertation must have the approval of the doctoral committee.

For instructions concerning the form and filing of the dissertation, see the *Manual for Graduate Students*.

MASTER OF FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for additional study in a student's particular field of interest rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

ADMISSION—An applicant for admission is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission, they must be removed early in the program. While making up deficiencies in prerequisite credits, the student must follow a program approved by his advisory committee. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School.

REQUIREMENTS—A minimum of 30 credits is required for the degree of Master of Forestry. These credits are to be taken in the best arrangement of courses in the 400 and 500 series suited to the needs of the individual student. Although not required, a maximum of 6 credits may be assigned to a thesis upon approval and recommendation of the head of the Department of Forestry. All requirements must be met within six years, or a period spanning seven summers.

TECHNICAL DEGREES

A maximum of 10 credits earned in extension classes of The Pennsylvania State College or in resident classes of other approved institutions may, under certain conditions, be applied toward the degree provided they fit into the program of the student.

A student should choose one field of work for his major interest, with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with an advisory committee. Ordinarily this committee consists of the head of the Department of Forestry and the professors in charge of the major and minor fields.

TECHNICAL DEGREES

ADMISSION—A graduate of the School of Chemistry and Physics, of the School of Engineering, or of the School of Mineral Industries of The Pennsylvania State College may be admitted to work for a technical degree, provided he submits evidence of having been engaged for a period of not less than three years in acceptable professional work in the field of engineering in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in engineering in a professorial rank in this institution, and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees. An applicant who is eligible for a technical degree is admitted to the Graduate School by the Dean of Admissions.

An applicant for a technical degree must file with the Dean of Admissions an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the matriculation fee of \$5.

Registration for these degrees is the same as for resident students. A candidate must be registered during two regular semesters.

DEGREES AND REQUIREMENTS—The technical degrees are as follows: Aeronautical Engineer, Architectural Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer, Fuels Engineer, Industrial Engineer, Ceramic Engineer, Mechanical Engineer, Engineer of Mines, Metallurgical Engineer, Petroleum Engineer, and Sanitary Engineer.

Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his application for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate School concerned.

In order to be recommended for a technical degree, the candidate must prepare a thesis on a subject related to his profession. He must register in the manner specified in the foregoing section and pay the registration and graduation fees. He may be required to appear in person to defend his thesis.

THESIS—Immediately following registration the candidate must submit for approval an outline of his proposed thesis; and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

For regulations concerning the form and filing of the thesis, see the *Manual for Graduate Students*.

GENERAL INFORMATION

FEES—

REGULAR FEES, PAID EACH SEMESTER:

Students registered for 10 or more credits:

Residents of Pennsylvania	\$ 95.00
Nonresidents of Pennsylvania	\$205.00

Students registered for fewer than 10 credits:

Residents of Pennsylvania, per credit	\$ 10.00
Nonresidents of Pennsylvania, on-campus studies, per credit	\$ 20.00
Nonresidents of Pennsylvania, off-campus research, per credit	\$ 10.00

Graduate assistants, fellows, and scholars:

Health service fee	\$ 7.50
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SPECIAL FEES, PAID AS OCCASION DEMANDS:

Applicable to all students, including graduate assistants, fellows, and scholars.

Admission to the Graduate School	\$ 5.00
Penalty for late registration	\$ 10.00
Penalty for late deferment of fees	\$ 5.00
Penalty for late payment of fees	\$1.00 to \$ 10.00
Change of schedule, each change	\$ 2.00
Graduation	\$ 10.00
Publication of dissertation abstract	\$ 35.00
Extra copy of transcript of record (one copy is free)	\$ 1.00

With reference to fees, courses that are scheduled for audit are considered the same as though they were scheduled for credit.

Summer sessions students who register for graduate courses pay the regular fees for the summer sessions.

Whenever it shall appear from any of the data presented as part of the application for admission that the applicant is not domiciled in Pennsylvania, the Dean of Admissions, when admission is granted to that applicant, assumes that the one admitted is a non-Pennsylvanian and includes that admission as part of the established out-of-State quota. A student so admitted is held liable for the out-of-State tuition fee.

If the one who is admitted believes that his circumstances do not justify his classification as a non-Pennsylvanian, he may petition the Dean of Admissions for reclassification.

Whenever such a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous domicile of the one admitted (or of his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding his admission, and, in addition, such other evidence as may appear pertinent to a complete review of his classification.

It is the responsibility of each student to appear at the Office of the Bursar to settle his account at the time it is due. Failure to pay bills or deferred payments

GENERAL INFORMATION

on the dates they are due will result in a late payment penalty of \$1 for each day of delinquency up to and including five days. The maximum late payment penalty of \$10 is charged for delinquency in excess of five days. Any student whose account is delinquent for more than 10 days is subject to suspension from the College.

GRADING SYSTEM—Grades are given to students solely on the basis of the instructor's judgment as to the student's scholarly attainment.

For graduate courses (500 series) one of three grades may be given:

H for Honors, indicating definitely superior attainment.

P for Pass, indicating acceptable but not superior attainment.

F for Fail, indicating failure to attain the minimum standards of work acceptable for credit in a degree program.

For 400 series courses one of six grades may be given:

3 — 90 to 100 inclusive 0 — 60 to 69 inclusive

2 — 80 to 89 inclusive —1 — 45 to 59 inclusive

1 — 70 to 79 inclusive —2 — 0 to 44 inclusive

Grades below 2 do not carry graduate credit.

HEALTH SERVICE—The College Health Service is available to graduate students as well as undergraduates. It endeavors to conserve, maintain, and promote the health of all students. Consult the *Manual for Graduate Students* for details concerning facilities and services.

LIVING ACCOMMODATIONS—A variety of living accommodations are available including rooms in private homes, lodging houses, and to a limited extent in dormitories. Boarding houses as well as restaurants are available for meals. The cost varies considerably but has been estimated at about \$19 to \$23 per week, including both board and room. The office of the Dean of Men and the office of the Dean of Women attempt to maintain a list of known vacancies. Prospective students should write to the appropriate office well in advance of the beginning of school because it may be very difficult to find a convenient location at the last minute.

Married students find accommodations in apartments, trailers, and rooms in private houses. Personal contact is essential, but assistance may be gained through contact with the office of the Dean of Men or an advertisement in the local newspaper.

Married students are eligible for residence in Eastview Terrace, a housing development consisting of small one- or two-bedroom units located on the campus. For details write to the Director of Housing, Old Main.

PLACEMENT SERVICE—The College Placement Service is designed to coordinate the placement activities of all the Schools and departments of the College. The services of the following divisions are available to students without charge.

The Placement Service functions primarily as a clearing house, bringing together students, faculty members, and representatives of organizations that are seeking college-trained personnel. Summer jobs other than those at camps or resorts are listed at this office.

The Teacher Placement Division is maintained to assist seniors, alumni, and graduate students in all departments in securing teaching positions for which they are qualified.

The Student Employment Division offers assistance to students in finding part-time employment in town and on the campus, as well as summer employment at camps and resorts. Students must be registered to be informed of jobs.

The divisions of the College Placement Service are available to all students, regardless of level, who are in need of counseling or guidance on employment problems.

SENIOR STUDENT PRIVILEGES—A senior student of The Pennsylvania State College lacking for graduation not more than 4 credits may be admitted to the Graduate School, receiving full residence credit. A senior student in the last semester lacking more than 4 credits for graduation may not be admitted to the Graduate School, but may be admitted to the graduate (500) courses (with permission of the Dean of the School and the Dean of the Graduate School) so far as his schedule permits. Advanced credits thus obtained may not be used as a part of the requirements for a bachelor's degree nor to reduce the minimum residence requirements for which all candidates for master's degrees are held after admission to the Graduate School.

SUMMER SESSIONS—A series of sessions covering a total period of 12 weeks are arranged each summer. During this time there are excellent opportunities for graduate work in many fields. It is not, however, possible to provide all the facilities which are available during the academic year. Detailed information can be secured from the *Summer Sessions Complete Announcement*, which is published about April 1 and can be obtained by writing to the Director of Summer Sessions.

ASSISTANTSHIPS, FELLOWSHIPS, AND OTHER AIDS

ASSISTANTSHIPS—Three types of appointments as graduate assistants in teaching or research are available, as listed below. All of them grant exemption from the incidental fee, the general fixed fee, and out-of-State tuition, but not from the health service fee and other specific fees such as matriculation, late registration, change of schedule, and graduation fees. They are intended only for superior graduate students who are so situated financially that with the aid of these assistantships they will be able to carry the loads specified without having to accept additional employment. For further details see the *Manual for Graduate Students*.

Applications should be addressed to the head of the department in which service is to be rendered.

QUARTER-TIME GRADUATE ASSISTANTSHIPS—Appointments for 9 months, September 16 to June 15 (stipend \$560), or for the fiscal year (stipend \$732); service one-fourth time; program four-fifths.

HALF-TIME GRADUATE ASSISTANTSHIPS—Appointments for 9 months, September 16 to June 15 (stipend \$1120), or for the fiscal year (stipend \$1464); service one-half time; program two-thirds.

THREE-QUARTER TIME GRADUATE ASSISTANTSHIPS—Appointments for 9 months, September 16 to June 15 (stipend \$1680), or for the fiscal year (stipend \$2196); service three-fourths time; program one-half.

COUNSELORSHIPS—The Dean of Men has available a number of appointments as resident counselors in the men's dormitories. Their responsibility is to work for the social, academic, and emotional adjustment of the undergraduate residents. Specialized training in personnel work is desirable, though not essential.

GENERAL INFORMATION

These appointments are for the academic year (nine months) and carry with them remission of fees for room and board, but not exemption from out-of-State tuition, nor from general and specific fees.

Applications should be addressed to the Dean of Men.

FELLOWSHIPS—Approximately 80 fellowships are available to enable superior graduate students to devote all their time to study and research. Fellows render no service, though in some cases they will be expected to conduct their research within broad fields specified by the donors. They will be expected to register for full-time graduate programs and not to accept additional employment. Fellowships yield stipends in varying amounts and carry with them exemption from the incidental fee, the general fixed fee, and out-of-State tuition, but not from the health service fee and other specific fees such as matriculation, late registration, change of schedule, and graduation fees.

Requests for additional information and application forms should be addressed to the head of the major department concerned.

The fellowships which are available will vary somewhat from year to year, but the following which were awarded for 1952-53 are typical:

ALLIED CHEMICAL AND DYE FELLOWSHIP—Open to graduate students in chemical engineering.

ALROSE CHEMICAL FELLOWSHIP—For the support of investigations in the field of chelating agents.

AMERICAN CYANAMID FELLOWSHIP—Open to graduate students in pure and applied chemistry.

AMERICAN PETROLEUM INSTITUTE FELLOWSHIPS (8)—Open to graduate students in organic chemistry, physical chemistry, and physics.

BRISTOL LABORATORIES FELLOWSHIP—Open to graduate students in organic chemistry.

CALIFORNIA COMPANY FELLOWSHIP—Open to graduate students in geology and mineralogy for studies in sedimentary petrology or stratigraphy.

DOW CORNING FELLOWSHIP—For the support of investigations in organosilicon compounds.

DU PONT FELLOWSHIP IN CHEMISTRY—Open to graduate students in chemistry who have been accepted as candidates for the doctor's degree.

DU PONT FELLOWSHIP IN ENGINEERING—Open to graduate students in mechanical engineering and engineering mechanics, preferably those working toward the Ph.D. degree.

ELI LILLY FELLOWSHIPS (2)—Open to graduate students in chemistry and physics for studies in organic chemistry or crystal analysis.

ELLIOTT FELLOWSHIP IN ENGINEERING RESEARCH—An annuity provided by W. S. Elliott of Pittsburgh for a student in engineering who must be a graduate of this College.

GENERAL MOTORS FELLOWSHIP—Open to graduate students in mechanical engineering for studies relating to internal combustion engines.

GULF COMPANY FELLOWSHIP IN MINERALOGY—Open to graduate students in mineralogy for studies in sedimentation.

GULF COMPANY FELLOWSHIP IN PHYSICS—In support of graduate work in the field of X-ray crystallography.

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HAMILTON STANDARD FELLOWSHIPS (3)—Open to graduates of this College in aeronautical engineering, electrical engineering, and mechanical engineering.

PENNSYLVANIA CO-OPERATIVE WILDLIFE RESEARCH FELLOWSHIPS (3)—Funds supplied by the Pennsylvania Game Commission for investigations dealing with wildlife management and the artificial propagation of game birds, mainly in the field of nutrition.

PENNSYLVANIA GRANGE LEAGUE FEDERATION FELLOWSHIP—For the support of research in poultry nutrition, with major interest in biochemistry.

SHELL COMPANY FELLOWSHIP IN CHEMICAL ENGINEERING—In support of graduate work in chemical engineering, preferably for students in their last year of doctoral work.

SHELL COMPANY FELLOWSHIP IN CHEMISTRY—Open to graduate students in various fields of chemistry.

UNION CARBIDE AND CARBON FELLOWSHIP—Open to graduate students in chemistry.

JOHN W. WHITE FELLOWSHIP—Award to one graduate of The Pennsylvania State College each year on the basis of scholarship, need, character, and attitude. The recipient may enroll in any approved college or university.

In addition, numerous grants are available from governmental agencies, industrial concerns, and foundations for the support of investigations of particular problems. Many of these permit full-time study and carry the same fee exemptions as the fellowships listed above. Detailed information can be secured from departments.

LOAN FUNDS—Loan funds are available to a limited extent. Applications should be addressed to the Dean of Men or the Dean of Women.

SCHOLARSHIPS—Forty graduate scholarships are available, without stipends, but with exemption from the incidental fee, the general fixed fee, and out-of-State tuition. Holders of these scholarships are required to take a full program of graduate work, and may be required to render some service.

There are also a few scholarships yielding stipends of various amounts, but without exemption from any fees.

Applications should be addressed to the Dean of the Graduate School and must be received by March 1 in order to be considered for the following academic year.

STUDENT EMPLOYMENT—Many students depend partly on their own earnings to help meet college expenses. The Student Employment Office, 112 Old Main, gives information on part-time jobs. Students not holding fellowships or assistantships who want part-time jobs should register with the Student Employment Office as soon as their class schedules have been arranged. While some students find regular part-time work, many of them depend on a series of odd jobs, some of which are of a continuing nature.

COURSE ABBREVIATIONS

Aero.E.	Aeronautical Engineering	Ger.	German
A.B.Ch.	Agricultural and Biological Chemistry	Greek	Greek
Agr.Ec.	Agricultural Economics	Hl.Ed.	Health Education
Agr.Ed.	Agricultural Education	Hist.	History
Agr.E.	Agricultural Engineering	H.Art	Home Art
Agr.	Agriculture—General	H.C.Rel.	Home-Community Relationships
Agro.	Agronomy	H.E.Ed.	Home Economics Education
A.H.	Animal Husbandry	Hort.	Horticulture
A.Ntr.	Animal Nutrition	Hl.Adm.	Hotel Administration
A.E.	Architectural Engineering	Hs.Eqp.	Housing and Home Equipment
Arch.	Architecture	I.Arts	Industrial Arts
Art	Art	Ind.Ed.	Industrial Education
Art Ed.	Art Education	I.E.	Industrial Engineering
Astro.	Astronomy	In.Adm.	Institution Administration
Bact.	Bacteriology	Int.Un.	International Understanding
Bot.	Botany	It.	Italian
Cer.	Ceramics	Journ.	Journalism
Ch.E.	Chemical Engineering	Latin	Latin
Chem.	Chemistry	Lib.Sc.	Library Science
Ch.Fm.	Child Development and Family Relationships	Math.	Mathematics
C.E.	Civil Engineering	M.E.	Mechanical Engineering
Cl.Tex.	Clothing and Textiles	M.E.Des.	Machine Design
Com.	Commerce	M.E.Lab.	Mechanical Engineering Laboratory
C.Con.S.	Commercial Consumer Services	Met.	Metallurgy
C.Lit.	Comparative Literature	Meteo.	Meteorology
D.H.	Dairy Husbandry	Min.Ec.	Mineral Economics
Dram.	Dramatics	Min.Pr.	Mineral Preparation
Econ.	Economics	Min.	Mineralogy
Ed.	Education	Mng.	Mining
E.E.	Electrical Engineering	Music	Music
El.Lab.	Electrical Engineering Laboratory	Mus.Ed.	Music Education
Eng.	Engineering	Pet.E.	Petroleum and Natural Gas
Mchs.	Engineering Mechanics	Phil.	Philosophy
Engl.	English	Ph.Ed.	Physical Education
E.Cmp.	English Composition	Phys.	Physics
E.Lit.	English Literature	Pol.S.	Political Science
Ent.	Entomology	Port.	Portuguese
H.Mgmt.	Family Economics and Home Management	P.H.	Poultry Husbandry
Fd.Ntr.	Foods, Nutrition, and Health	Psy.	Psychology
For.	Forestry	P.U.	Public Utilities
Fr.	French	Recr.	Recreation
Fuel T.	Fuel Technology	R.Soc.	Rural Sociology
Gen.H.E.	General Home Economics	Rus.	Russian
Geog.	Geography	Soc.	Sociology
Geol.	Geology	Sp.	Spanish
G.&G.	Geophysics and Geochemistry	Spch.	Speech
		Sph.Ed.	Speech Education
		Zool.	Zoology

GRADUATE COURSES

NUMBERING SYSTEM

The course descriptions which follow are arranged alphabetically. If any course cannot be located readily, refer to the table of contents, pages 2 and 3. Courses are numbered as follows:

UNDERGRADUATE COURSES, numbered 1 to 399, are general courses accepted in fulfillment of the requirements for the bachelor's degree.

UPPER-CLASS AND GRADUATE COURSES, numbered 400 to 499, are advanced courses open for credit to undergraduate students of at least junior standing and to graduate students under the restriction that no more than 12 credits in these courses may be offered in fulfillment of the requirements for the M.A. and M.S. degrees.

GRADUATE COURSES, numbered 500 to 599, are for graduate students only. The name of the instructor may follow the description. Seniors not required to carry a full program for graduation, with permission of the Dean of the School in which they are enrolled and of the Dean of the Graduate School, may attend such courses and be allowed credit under special conditions. *Many departments reserve the right to say which of certain graduate courses may be given in any semester; the heads of departments should be consulted.*

The figures in parentheses following the course title show the number of credits granted for that course. Many graduate courses are offered in the summer sessions. When these courses are also given during the regular academic year, they are not listed separately as summer session courses in this announcement. For a complete list of courses given during a specific summer session, consult the *Complete Announcement of the Summer Sessions* for that year. In the section which follows, courses given during the summer session (*but not during the regular academic year*) have numbers followed by the letter "S." Courses given in extension only have numbers followed by the letter "X."

AERONAUTICAL ENGINEERING

PROFESSOR DAVID J. PEERY, M.S.E., C.E., Ph.D.

Head of the Department

500. THESIS (1-9)

501. AIRPLANE STABILITY AND CONTROL (3) General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aero.E. 403.

503. AIRPLANE PERFORMANCE (3) Methods of performance prediction and performance flight testing for high-speed aircraft and missiles. Prerequisite: Aero.E. 403.

AERONAUTICAL ENGINEERING

504. **ROTARY WING AIRCRAFT** (3) Types of rotary wing aircraft; helicopter performance, stability, and control; structural and vibration problems. Prerequisites: Aero.E. 403, 409.
505. **AIRCRAFT VIBRATION AND FLUTTER** (3) Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aero.E. 1, M.E.Des. 8.
506. **ADVANCED AIRCRAFT STRUCTURES** (3) Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing deformations of multi-cell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisite: Aero.E. 409.
507. **AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES** (3) Types of jet propulsion installations, thermodynamic cycles, analysis of compressors, combustion chambers, and turbines. Prerequisite: Aero.E. 410.
510. **AERODYNAMICS OF COMPRESSIBLE FLUIDS** (3) One-dimensional motion, shock waves, flow in nozzles, two-dimensional flow, airfoil theory, Prandtl-Meyer flow, method of characteristics. Prerequisites: Aero.E. 412, M.E. 2.
511. **AERODYNAMICS OF A PERFECT FLUID** (3) Euler's dynamic equations, complex potential, conformal transformation, thin airfoils, Biot-Savart law; Prandtl three-dimensional airfoil theory. Prerequisite: Aero.E. 412.
512. **AERODYNAMICS OF A VISCOUS FLUID** (3) Navier-Stokes equations, incompressible and compressible boundary layer theory, jet and wake problems, hydrodynamic stability, turbulence. Prerequisite: Aero.E. 412.
513. **RESEARCH IN AERONAUTICAL ENGINEERING** (1-15 per semester) Investigation of a theoretical or experimental project in aeronautical engineering.
514. **AERONAUTICAL ENGINEERING SEMINAR** (1 per semester) Current literature and special problems in aeronautical engineering.
515. **AERODYNAMICS** (3) Airflow, airplane performance. For students with undergraduate training in science or engineering curriculums other than aeronautical engineering.
516. **AIRCRAFT STRUCTURES** (3) Analysis of semi-monocoque aircraft structures. For students with undergraduate training in science or engineering curriculums other than aeronautical engineering.
517. **DYNAMICS OF AIRCRAFT** (3) Steady and transient vibrations, Laplace transformation, electrical analogies; introduction to flutter, dynamic stability, aeroelasticity, and servomechanisms.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401a,b,c. **AERONAUTICAL ENGINEERING PROJECTS** (2-12)
402. **AIRPLANE ENGINE DESIGN** (4)
403. **APPLIED AERODYNAMICS** (3)
404. **AIRPLANE DESIGN** (4)
407. **ROTARY WING AIRCRAFT** (3)

- 408. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3)
- 409. AIRPLANE DETAIL DESIGN (3)
- 410. AIRCRAFT PROPULSION (3)
- 411. AIRCRAFT STRUCTURES (3)
- 412. THEORETICAL AERODYNAMICS (3)
- 413. GUIDED MISSILES (3)

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

PROFESSOR HOWARD O. TRIEBOLD, M.S., Ph.D.

Acting Head of the Department

- 501. ENZYMES (2) Investigations and theories concerning nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: A.B.Ch. 437. *Professor Jensen*
- 502. PHYSICAL CHEMISTRY OF THE CELL (3) Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: A.B.Ch. 426. *Professor Lisse*
- 503. RESEARCH (3-15) Prosecution of an assigned problem under the guidance of an instructor. Prerequisite: A.B.Ch. 417. For certain problems additional courses may be considered as prerequisite.
- 504. THESIS RESEARCH (3-15 per semester)
- 505. VITAMINS AND DIETARY DEFICIENCY DISEASES (2) Lectures, conferences, and assigned reading. Prerequisite: A.B.Ch. 437. *Professor Guerrant*
- 506. VITAMIN ASSAY METHODS (2) Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: A.B.Ch. 505. *Professor Guerrant*
- 507a. SEMINAR IN PHYSIOLOGICAL CHEMISTRY AND NUTRITION (1)
Professors Guerrant, Anderson, Boucher, Miller, and Pritham
- 507b. SEMINAR IN FOODS AND ANALYTICAL CHEMISTRY (1)
Professors Triebold, Althouse, and Shigley
- 507c. SEMINAR IN PLANT, SOIL, AND INSECTICIDE CHEMISTRY (1)
Professors Frear and Jensen
- 508. RESEARCHES IN PLANT CHEMISTRY (3) Lectures and assigned readings reviewing the more important chemical investigations in plant chemistry. Prerequisite: A.B.Ch. 437. *Professor Jensen*
- 509. BIOCHEMICAL METHODS (3) An advanced laboratory course involving special methods used in biochemical research on plant and animal materials. Prerequisite: A.B.Ch. 437. *Professor Anderson*
- 510. PROTEINS (2) Chemical constitution of proteins, their physical and biochemical properties, their function in nutrition, and their fate in metabolism. Prerequisite: A.B.Ch. 437. *Professor Anderson*

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

511. CARBOHYDRATES (2) Study of research work dealing with carbohydrates and their metabolism in plant and animal organisms. Prerequisite: A.B.Ch. 437.
Professor Jensen
512. LIPIDS (2) Investigations on biochemistry of fats and related substances. Prerequisite: A.B.Ch. 437.
Professor Triebold
513. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (4) Laboratory course, quantitative in nature, valuable as preparation for A.B.Ch. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: A.B.Ch. 425 or Chem. 41, 43.
Professor Lisse
515. BIOMETRY (2) Application of statistical methods to research problems in biochemistry and biology. Prerequisites: A.B.Ch. 437, Math. 30. *Professor Miller*
516. CHEMISTRY OF INSECTICIDES AND FUNGICIDES (2) Lectures and assigned readings dealing with chemical investigations of materials used in the control of insects and plant diseases. Prerequisites: Chem. 30, 31; A.B.Ch. 425 or Chem. 41, 43; A.B.Ch. 417.
Professor Frear
517. ENDOCRINE SECRETIONS (2) Chemistry of hormones and their physiological significance. Prerequisite: A.B.Ch. 437.
Professor Pritham
518. MINERAL METABOLISM (2) Utilization and function of mineral elements in animal nutrition. Prerequisite: A.B.Ch. 437.
Professor Boucher

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 403. DAIRY CHEMISTRY (3) | <i>Professor Shigley</i> |
| 404. FOOD CHEMISTRY (4) | <i>Professor Triebold</i> |
| 413. PRINCIPLES OF ANIMAL NUTRITION (3) | <i>Professor Miller</i> |
| 417. METHODS OF AGRICULTURAL ANALYSIS (4) | <i>Professor Triebold</i> |
| 418. PLANT ANALYSIS (4) | <i>Professor Jensen</i> |
| 421. CHEMISTRY OF MILLING AND BAKING (3) | <i>Professor Triebold</i> |
| 425. BIOPHYSICAL CHEMISTRY (4) | <i>Professor Lisse</i> |
| 426. BIOCOLLOIDS (3) | <i>Professor Lisse</i> |
| 427. POTENTIOMETRIC THEORY AND TECHNIQUE (3) | <i>Professor Lisse</i> |
| 437. GENERAL BIOCHEMISTRY (5) | <i>Professor Pritham</i> |
| 438. PHYSIOLOGICAL CHEMISTRY (CLINICAL METHODS) (5) | <i>Professors Anderson and Pritham</i> |
| 439. PROBLEMS IN AGRICULTURAL CHEMISTRY (3-5) | |
| 440. PLANT BIOCHEMISTRY (3) | <i>Professor Jensen</i> |

AGRICULTURAL ECONOMICS

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.

Head of the Department of Agricultural Economics and Rural Sociology

500. SEMINAR IN AGRICULTURAL ECONOMICS (1-6) Review of current literature and problems.

502. ECONOMIC PROBLEMS IN THE MARKETING OF FRUITS AND VEGETABLES (3)
Professor Lee
503. RESEARCH METHODS IN FARM MANAGEMENT (1-3) Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Agr.Ec. 6, Econ. 14. *Professor Barr*
504. AGRICULTURAL PRICE AND INCOME POLICY (3) Analysis of farm prices, income consequences for producers and consumers, and effects on resource use; evaluation of policy, considerations in policy making. Prerequisites: Agr.Ec. 420, Econ. 405.
Professor Brandow
505. ADVANCED AGRICULTURAL STATISTICS (3) Multiple correlation, curve fitting, analysis of variance, selection of samples, and other techniques applicable to the rural social sciences. Prerequisite: 3 credits in statistics. *Professor Brandow*
507. SEMINAR IN FARM MANAGEMENT (1-6) Special problems relating to organization and operation of the farm business. Prerequisites: Agr.Ec. 6, Econ. 14.
515. ECONOMIC PROBLEMS IN THE MARKETING OF DAIRY PRODUCTS (3) Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing. *Professor Pierce*
517. PROBLEMS AND POLICIES OF FARMER CO-OPERATIVES (3) Specific types of co-operative organizations, their problems, policies, and progress; relationships existing among co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Agr.Ec. 17.
Professor Becker
522. ADVANCED FARM APPRAISAL (3) Land value theory; methods of land valuation; field practice in farm appraisal. Prerequisite: Agr.Ec. 6.
525. RESEARCH METHODS IN RURAL SOCIAL SCIENCES (2) Scientific method in planning and conducting research. Prerequisite: 9 credits in social sciences.
Professor John
533. ECONOMIC PROBLEMS IN THE MARKETING OF POULTRY AND EGGS (3) Detailed treatment of special problems such as marketing particular types and grades of products, operation of certain markets, and performance of selected marketing functions. Prerequisites: Econ. 14, P.H. 1.
Professor Baker
540. THESIS IN AGRICULTURAL ECONOMICS (6) Preparation of the required thesis for the degree of Master of Science in agricultural economics while in residence at the College.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 400, 400X. PUBLIC POLICIES IN AGRICULTURE (1-2)
404. FARM FINANCE (2) *Professor Miller*
407. ADVANCED FARM MANAGEMENT (3) *Professor Miller*
420. AGRICULTURAL PRICES (3) *Professor Brandow*
421. LAND ECONOMICS (3) *Professor Frey*

AGRICULTURAL EDUCATION

PROFESSOR HENRY S. BRUNNER, M.S., Ph.D.

Head of the Department

- 501v. HISTORY OF AGRICULTURAL EDUCATION (1-3) Development of training for agricultural vocations; emphasis upon introduction of agricultural instruction into the high school program. *Professor Hall*
- 502v, 502vX. TEACHING VOCATIONAL AGRICULTURE (1-3) Organization of instruction with respect to vocational objectives, methods of presentation, supervision of practice, pupil evaluation of goals, and follow-up.
- 503v, 503vX. RESEARCH IN AGRICULTURAL EDUCATION (1-6 per semester) Individual study problems in various phases of agricultural education, such as evaluation of teaching, teaching procedures, and teacher preparation. *Professor Brunner and Staff*
- 504v. AGRICULTURAL EDUCATION SEMINAR (1 per semester) *Professor Brunner and Staff*
- 506v, 506vX. PROBLEMS IN COUNTY VOCATIONAL SUPERVISION (1-3) Needs of county supervisors and vocational directors; co-operation with county superintendents, supervisory duties, plans of work, community meetings and organizations. *Professor Stevens*
- 508v. STATE AND COUNTY ADMINISTRATION AND SUPERVISION OF AGRICULTURAL EDUCATION (1-3) Organization and administration of state, county, township, and district systems of agricultural education; state and federal legislation. *Professor Brunner*
- 509v, 509vX. TEACHER TRAINING IN AGRICULTURAL EDUCATION (1-6) Construction of college curriculums, courses of study, and organization of college departments for training agricultural teachers.
- 520v, 520vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Methods of procedure in investigation and experimentation in education, accompanied by a critical examination of studies made in agricultural education. *Professor Brunner*
- 521v, 521vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Continuation of Agr.Ed. 520v; emphasis upon statistical techniques for students' individual problems. *Professor Hall*
- 522v, 522vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) Organization and administration of agricultural education in its local bearings; field laboratory surveys of local school conditions. *Professor Brunner and Staff*
- 523v, 523vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) *Professor Brunner and Staff*
- 524v, 524vX. ANNUAL PLAN OF WORK (1-3) Detailed study of the agricultural education needs of each student's community and outlining annual plans of work. *Professor Brunner*

AGRICULTURAL EDUCATION

525v. MASTER'S THESIS (1-6) Conferences and assignments in preparation of a thesis for the degree of Master of Science in agricultural education.

Professor Brunner and Staff

530v. AGRICULTURAL COLLEGE TEACHING (3) Selection and organization of subject matter for specific courses, methods of learning, teaching devices, technique of teaching, and measurements of results of teaching. *Professor Brunner and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

416v. RURAL EDUCATION (3) *Professor Hall*

417v, 417vX. RURAL EDUCATION SURVEY (2) *Professor Brunner*

418v, 418vX. SURVEY OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3)

Professor Brunner

420v, 420vX. ADVANCED VISUAL AND OTHER SENSORY AIDS IN TEACHING AGRICULTURE (1-6) *Professor McClay*

422v, 422vX. SUPERVISION OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3)

Professor McClay

434v, 434vX. AGRICULTURAL DEVELOPMENTS (1-6)

Professor Stevens

AGRICULTURAL ENGINEERING

PROFESSOR ARTHUR W. CLYDE, M.S.

Acting Head of the Department

500. ADVANCED ELECTRO-AGRICULTURE (1-6) Investigations in the application of electrical energy to processing, storing, and handling agricultural products. Seminar, written reports.

501. ADVANCED FARM MACHINERY (1-6) Application of agricultural engineering principles to design and operation of farm machinery. Prerequisite: Agr.E. 10.

508. ADVANCED PROBLEMS IN FARM MECHANICS (1-15) Problems in farm shop practice and agricultural engineering related to the farm mechanics program of vocational education in agriculture. Prerequisites: Agr.E. 8, 14; or teaching experience in farm mechanics.

509. RESEARCH IN AGRICULTURAL ENGINEERING (1-4)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. AGRICULTURAL ENGINEERING PROBLEMS AND SEMINAR (1-7)

401a,b,c,dS. FARM MECHANICS FOR TEACHERS OF VOCATIONAL AGRICULTURE (1½-6)

402. FUNCTIONAL DESIGN OF FARM STRUCTURES (3)

405. ADVANCED FARM ELECTRIFICATION (3)

406. ADVANCED DAIRY ENGINEERING (3)

AGRICULTURE—GENERAL

Consult VICE-DEAN RUSSELL B. DICKERSON, M.S., Ph.D.

The following course may be taken for graduate credit under the restrictions in force:

400. INTRODUCTORY BIOMETRY (3)

AGRONOMY

PROFESSOR HERBERT R. ALBRECHT, M.S., Ph.D.
Head of the Department

501. ADVANCED SOIL FERTILITY (4) Interpretation of fertility experiments and diagnosis of soil-plant relationships through field appraisal, analysis, and plant symptoms. Prerequisites: Agro. 431, Bot. 406. *Professor Merkle*

503. AGRONOMY SEMINAR (1) Weekly meeting where papers and discussions will be presented by students and staff members. Each student will present a paper on some phase of his major subject.

506. SOIL CHEMISTRY (4) Analyses of important chemical and biochemical reactions occurring in soils, conditions which control these reactions and their importance in soil genesis and plant growth; laboratory work in the more typical and significant analytical procedures; lectures, review of current literature, and practicum. Prerequisites: Agro. 419; A.B.Ch. 417 or Chem. 20. *Professor Satchell*

507. SOIL PHYSICS (4) Physical properties of the soil; factors affecting them; their measurements, evaluation, and influence in determination of soil productivity. Prerequisites: Agro. 419, Phys. 215, A.B.Ch. 425. *Professor Alderfer*

509. GENETICS OF CROP PLANTS (3) Inheritance in crop plants with particular reference to factor interaction, genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 422. *Professor Carnahan*

510. THE APPLICATION OF CYTOGENETICS TO PLANT BREEDING (3) Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 505. *Professor Carnahan*

511. THE BREEDING OF FARM CROPS (3) Application of genetic principles to improvement of crop plants. Prerequisite: Hort. 7.

512. FIELD PLOT TECHNIQUE (4) Ramifications of analysis of variance technics; combining and analyzing data from several experiments; selection of valid error terms. Prerequisite: Math. 8 or Agr. 400. *Professor Fortmann*

516. HUMUS (2) Origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 419, 431. *Professor Richer*

517. FARM CROPS ECOLOGY (2) Ecological factors influencing distribution and production of field crops. Prerequisites: Math. 8, Bot. 406. *Professor Huber*

518. GROWTH AND MANAGEMENT OF FORAGE CROPS (3) Factors affecting growth and development of forage crops with particular reference to effects of environment, defoliation, and management practices. Prerequisites: Agro. 423, Bot. 406.
Professor Sprague
520. SPECIAL SOILS PROBLEMS (1-6 per semester) Provides basic or practical training in the soils sciences by means of library, field, and laboratory assignments.
545. THE APPLICATION OF STATISTICS TO FIELD EXPERIMENTS (4) Use of advanced experimental designs in planning, analyzing, and interpreting experiments; includes lattice designs, factorials, confounding, simple and multiple covariance techniques. Prerequisite: Agro. 512.
Professor Fortmann
550. SPECIAL CROPS PROBLEMS (1-6 per semester) Provides basic or practical training in the crops sciences by means of library, field, and laboratory assignments.
582. SEMINAR IN BREEDING AND GENETICS OF FARM CROPS (1-8 per semester)
- 583S. LABORATORY METHODS IN FIELD CROPS (3) Prerequisite: Agro. 512.
Professor Carnahan
591. THESIS RESEARCH (1-15 per semester) Thesis research in the various crops and soils sciences falling within the research program of the department.
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
402. THE NATURE OF SOIL MINERALS (3) *Professor Jeffries*
416. THE CLASSIFICATION AND MAPPING OF SOILS (4) *Professor Higbee*
419. SOIL PROPERTIES (5) *Professor Merkle*
422. SOIL CONSERVATION (3) *Professor Alderfer*
423. PASTURE AND GRASSLAND MANAGEMENT (3) *Professor Washko*
431. SOIL FERTILITY AND MANAGEMENT (3) *Professor Merkle*
490. AGRONOMIC PRACTICES (1-6)

ANIMAL HUSBANDRY

PROFESSOR FRANKLIN L. BENTLEY, M.S.
Head of the Department

501. PEDIGREE STUDY (1-6) Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book.
Professor Henning
502. RESEARCH IN MEATS (1-6 per semester) Investigation of methods for handling, cutting, processing, freezing, and curing meat and meat products. Prerequisite: A.H. 421.
Professor Ziegler
503. LIVESTOCK MANAGEMENT (3) Handling of purebred herds and flocks; relation of livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding.
Professor Bentley and Staff
504. LIVESTOCK HEALTH PROBLEMS (3) Problems dealing with regulations governing movement of livestock with special reference to control measures applicable

ANIMAL HUSBANDRY

to diseases and disease groups common to men and animals. Prerequisites: A.H. 5, 415. *Professor Bortree*

505. ADVANCED ANIMAL BREEDING (1-5) Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22. *Professor Henning*

506. RESEARCH IN ANIMAL HUSBANDRY (2-10 per semester) Prosecution of an assigned problem under the guidance of an instructor. Prerequisites: A.H. 415, 421; or 426.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

415. ADVANCED ANATOMY AND PHYSIOLOGY (3)

Professor Bortree

421. ADVANCED MEAT STUDIES (3)

Professor Ziegler

423. ADVANCED STOCK JUDGING (2)

Professor Henning

424. ANIMAL HUSBANDRY SURVEY (1)

Professor Bentley and Staff

426. LIVESTOCK MARKETS AND MARKETING (3)

Professor Bentley

431. ADVANCED MEAT JUDGING (1)

ANIMAL NUTRITION

PROFESSOR RAYMOND W. SWIFT, M.S., Ph.D.

Head of the Department

500. RESEARCH IN ANIMAL NUTRITION (Credit to be arranged) Participation in the research program of the Department of Animal Nutrition and independent investigation. The available facilities make it possible to accommodate only a small number of students.

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

401. PHYSIOLOGY OF NUTRITION (3)

Professor Black

402. PHYSIOLOGY OF NUTRITION (3)

Professor French

ARCHITECTURAL ENGINEERING

Consult PROFESSOR LOUIS A. RICHARDSON, M.S.

502. ARCHITECTURAL ENGINEERING (3-8) Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar.

Professor Richardson and Staff

503. ARCHITECTURAL ENGINEERING (4-8) Continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed constructions are studied. Practicum and seminar.

Professor Fox

ARCHITECTURAL ENGINEERING

504. ARCHITECTURAL ENGINEERING (4-8) Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar. *Professor Richardson and Staff*
506. ARCHITECTURAL ENGINEERING RESEARCH (1-15) Presentation of an assigned problem under the guidance of an instructor. *Professors Richardson and Fox*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. ARCHITECTURAL ENGINEERING (3)
402. ARCHITECTURAL ENGINEERING (4)
403. ARCHITECTURAL ENGINEERING (3)
420. ARCHITECTURAL ENGINEERING (3)
421. ARCHITECTURAL ENGINEERING (4)
422. ARCHITECTURAL ENGINEERING (3)
423. ARCHITECTURAL ENGINEERING THESIS (2)
424. ARCHITECTURAL ENGINEERING THESIS (5)

ARCHITECTURE

PROFESSOR MILTON S. OSBORNE, M.S.

Head of the Department

501. ARCHITECTURAL DESIGN (4-8) Problems in advanced planning and design, including study of group composition. Practicum and seminar.
Professor Osborne and Staff
502. ARCHITECTURAL RESEARCH (2-12) Prosecution of assigned problems under the guidance of an instructor.
Professor Osborne and Staff
503. ARCHITECTURAL HISTORY RESEARCH (3-12) Original research in architectural history. Seminar and written reports.
Professor Dickson and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

410. ADVANCED ARCHITECTURAL DESIGN (2-12) *Professor Osborne and Staff*
411. ADVANCED ARCHITECTURAL DESIGN (8)
412. ADVANCED ARCHITECTURAL DESIGN AND THESIS (8)
421. CONTEMPORARY ARCHITECTURE (3) *Professor Norton*

ART

Consult PROFESSOR HAROLD E. DICKSON, M.A., Ph.D.

(See also courses in Art Education below.)

500. ART RESEARCH (2-6) Prosecution of assigned problems under the guidance of an instructor. *Professor Galbraith*

ART

501. ITALIAN PAINTING (2-6) Investigations of early Italian painting. Seminar, written reports. *Professor Dickson*
502. MEDIEVAL SCULPTURE (2-6) Sculpture of Italy and France from the 9th to the 13th centuries. Seminar, written reports. *Professor Dickson*
503. ART HISTORY RESEARCH (3-12) Original investigation in art history, to be pursued independently or concurrently with course work in particular fields. Prerequisite: 6 credits in history of art. *Professor Dickson and Staff*
504. SEMINAR: ART LITERATURE AND ICONOGRAPHY (2-6) Methods of research in the fine arts; survey of the literature of art; studies in iconography. Prerequisite: 6 credits in history of art. *Professor Dickson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. OIL PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9) *Professor Dickson*
- 403S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Professor Dickson*
- 404S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Professor Dickson*
410. WATER-COLOR PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9) *Professor Case*
- 442S. ART OF THE MIDDLE AGES AND RENAISSANCE IN ITALY (3)
- 443S. ART IN AMERICA (3)
- 444S. ART IN NORTHERN EUROPE (3)
490. LIFE DRAWING (3) *Professor Case*

ART EDUCATION

Consult PROFESSOR VIKTOR LOWENFELD

514. FUNCTIONAL RELATIONSHIPS IN CRAFTS (3) Relationships of material design and purpose in crafts discussed by means of outstanding products of different materials, periods, and cultures. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts. *Professor Emerson*
534. CREATIVE ART ACTIVITY FOR THE HANDICAPPED (3) Specific methods for development of creative art activity with the physically, mentally, emotionally, and socially handicapped; adjustive effect upon them. Prerequisite: 6 credits in art education or 6 in special education or 6 in psychology. *Professor Lowenfeld*
586. RESEARCH IN ART EDUCATION (3-9) Current experiments in art education; required of students working for a master's degree in art education. *Professor Lowenfeld*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

402. METHODS OF TEACHING DRAWING IN THE GRADES (2-3) *Professor Emerson*
404. METHODS OF GRAPHICS AND ILLUSTRATIONS (3) *Professor Emerson*
414. ADVANCED CRAFTS FOR TEACHERS (3-6) *Professor Emerson*
434. ART APPRECIATION IN THE EDUCATIONAL PROGRAM (2-3)
- 434b, 434bX. ART IN THE ELEMENTARY SCHOOL (2-3) *Professor Lowenfeld*

434c, 434cX. ART IN THE SECONDARY SCHOOL (2-3)	<i>Professor Lowenfeld</i>
434d. ART SUPERVISION (3)	<i>Professor Lowenfeld</i>
486, 486X. CURRENT PROBLEMS IN ART EDUCATION (2-3)	<i>Professor Lowenfeld</i>
487. MURAL PAINTING IN SCHOOLS (3)	<i>Professor Lowenfeld</i>
488. ADVANCED MURAL PAINTING IN SCHOOLS (3)	<i>Professor Lowenfeld</i>

ASTRONOMY

PROFESSOR D. C. DUNCAN, M.A., Ph.D.
Acting Head of the Department of Physics

The following courses may be taken for graduate credit under the restrictions in force:

- 430. GENERAL ASTRONOMY FOR TEACHERS (3)
- 486. ASTRONOMICAL PHOTOGRAPHY (3)
- 490-491. INTRODUCTION TO ASTROPHYSICS (3 each)

BACTERIOLOGY

PROFESSOR ROBERT W. STONE, Ph.D.
Head of the Department

- 504. DAIRY BACTERIOLOGY PROBLEMS (2-15) Research on microorganisms of importance in dairy sanitation, milk production, and manufacture of dairy products. Prerequisite: 12 credits in bacteriology.
- 505. PATHOGENIC BACTERIOLOGICAL PROBLEMS (2-15) Problems on the morphological, cultural, and immunological characteristics of pathogenic bacteria. Prerequisite: 12 credits in bacteriology.
- 506. RESEARCH (2-15) Research in bacteriology for students who are doing their major work in this subject for the master's or doctor's degree. Prerequisite: 12 credits in bacteriology.
- 507. BACTERIOLOGICAL SEMINAR (1-6) Reports on current fields of research. Prerequisite: 12 credits in bacteriology.
- 508. PHYSIOLOGY OF BACTERIA (2) Metabolic processes of bacteria as influenced by their environment; the mechanism of fermentation and respiration of microorganisms. Prerequisite: Bact. 412.
- 508a. LABORATORY IN PHYSIOLOGY OF BACTERIA (2) Laboratory work to accompany the lectures given in Bact. 508. Prerequisite: Bact. 412.
- 509. FERMENTATION (2) Chemical action of microorganisms on their environment; theories of carbohydrate breakdown and application of these theories to industrial and agricultural fermentations. Prerequisites: Bact. 1, Chem. 31.

BACTERIOLOGY

510. METHODS AND ANALYSES IN BACTERIAL FERMENTATION (2) Laboratory procedures and problems in fermentation to accompany Bact. 509. Prerequisites: Bact. 1, Chem. 31.
511. BACTERIOLOGICAL LITERATURE (2-4) Assigned reading and conferences dealing with a student's research problem. May be taken only in those instances where a student is not scheduling Bact. 504, 505, or 506. Discussion and written reports. Prerequisite: 12 credits in bacteriology.
512. LABORATORY IN ADVANCED BACTERIOLOGICAL TECHNIQUES (2-6) Certain techniques used in research including work with single cell isolation, Warburg apparatus, tissue culture and serology. May be repeated with credit. Prerequisite: 12 credits in bacteriology.
515. PATHOGENIC BACTERIOLOGY AND VIROLOGY (3-6) Important bacterial, rickettsial, and viral agents parasitizing man and animals; immunological and epidemiological considerations of host response. Prerequisite: Bact. 410.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. GENERAL MICROBIOLOGY (4)
407. BACTERIOLOGY PROBLEMS (2-9)
410. IMMUNOLOGY AND SEROLOGY (4)
411. BACTERIOLOGICAL SURVEY (1)
412. ADVANCED BACTERIOLOGY (4)
413. SOIL MICROBIOLOGY (3)
414. FOOD MICROBIOLOGY (4)
416. INDUSTRIAL MICROBIOLOGY (4)

BOTANY

PROFESSOR HENRY W. POPP, M.S., Ph.D.
Head of the Department

500. PLANT PHYSIOLOGY SEMINAR (1 per semester) Selected topics from recent literature; staff and student reports on current research.
Professors Popp and Van Norman
501. THE PHYSIOLOGY OF THE FUNGI (3) Chemical composition, metabolism, toxic and stimulating agencies, spore germination, growth and irritability of the fungi. Prerequisites: Bot. 406, 419, and preferably Chem. 32. *Professor Fergus*
505. CYTOLOGY AND CYTOGENETICS (3) Cells and their components; nuclear and cell division, meiosis and fertilization; the chromosome mechanism of heredity. Prerequisites: Bot. 22, 421. *Professor Wright*
506. COMPARATIVE ANATOMY OF VASCULAR PLANTS (3) Structure of the Tracheophyta from a phylogenetic standpoint. Prerequisite: Bot. 407. *Professor Kribs*
508. PROBLEMS IN GENETICS (2-6) Problems to suit needs of individual students; conferences and laboratory work. Prerequisite: Bot. 422. *Professor Wright*

509. PHYSIOLOGY OF PATHOGENICITY (3) Physiological processes of plant pathogenic bacteria and fungi occurring during incubation, ingress, and infection. Prerequisite: Bot. 10, 11, or 419. *Professor Paddock*
511. PHYSIOLOGY OF PLANT GROWTH AND DEVELOPMENT (2-4) Prerequisite: Bot. 406. *Professor Popp*
512. PHYSIOLOGY OF PLANT METABOLISM (2-4) Prerequisite: Bot. 406. *Professor Van Norman*
513. WATER AND MINERAL RELATIONS OF PLANTS (2-4) Absorption of water and minerals; transport of materials within the plant; physiology of transpiration. Prerequisite: Bot. 406. *Professor Van Norman*
515. DISEASE RESISTANCE IN PLANTS (2-4) Stability of resistance, selection of resistant material, economics of control, special problems. Prerequisites: Bot. 22 or 32, 10. *Professors Wernham and Mills*
518. BOTANICAL PROBLEMS (1-15) per semester *Professor Popp and Staff*
519. PLANT VIRUSES (3) Nature, symptomatology, transmission, and control of virus diseases of plants. *Professor Boyle*
520. PLANT PATHOGENIC BACTERIA (3) Bacteria causing plant diseases, methods of identification, inoculation and control. *Professor Kneebone*
521. MOLDS, YEASTS, AND ACTINOMYCETES (3) Morphology and taxonomy of fungi important in microbiology; identification and techniques of study. *Professor Sinden*
522. MYXOMYCETES, PHYCOMYCETES, AND ASCOMYCETES (4) Morphology, taxonomy, phylogeny, and life histories; identification and field work. Prerequisite: Bot. 419. *Professor Fergus*
523. BASIDIOMYCETES AND FUNGI IMPERFECTI (4) Morphology, taxonomy, phylogeny, and life histories. Prerequisite: Bot. 419. *Professor Fergus*
524. SEMINAR IN GENETICS (1 per semester) Review of current research publications in genetics. *Professor Wright*
- 527aS, 527bS. PLANT BIOLOGY (3 per course) (a) Structure and physiology; (b) reproduction processes, development and relationships of plant groups. Methods of obtaining materials and setting up experiments. Given in alternate years. Prerequisite: general biology or general botany courses.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

406. PLANT PHYSIOLOGY (4) *Professor Van Norman*
407. PLANT ANATOMY (3) *Professor Kribs*
408. PLANT PATHOLOGICAL TECHNIQUES (3) *Professor Paddock*
409. PLANT ECOLOGY (3) *Professor Kovar*
412. ADVANCED FOREST PATHOLOGY (3) *Professor Fergus*
414. TAXONOMY OF VASCULAR PLANTS (3) *Professor Wahl*
415. MORPHOLOGY OF THE ALGAE (3) *Professor Wahl*
416. MORPHOLOGY OF THE BRYOPHYTES (2) *Professor Grove*

BOTANY

417. MORPHOLOGY OF THE TRACHEOPHYTES EXCLUSIVE OF ANGIOSPERMS (3)
Professor Grove
418. BOTANICAL PROBLEMS (1-6)
Professor Popp and Staff
419. MYCOLOGY (3)
Professor Fergus
420. MORPHOLOGY OF THE ANGIOSPERMS (3)
Professor Grove
421. BOTANICAL TECHNIQUE (3)
Professor Grove
422. ADVANCED GENETICS (3)
Professor Wright
424. COMMERCIAL TROPICAL WOODS (3)
Professor Kribs
- 425a, 425b. STRUCTURE OF ECONOMIC PLANTS (3-6)
Professor Grove
426. PHOTOMICROGRAPHY (2)
Professor Kribs
427. ADVANCED SYSTEMATIC BOTANY (1-6)
Professor Wahl
428. ADVANCED PLANT PATHOLOGY (2)
Professor Paddock
- 432S. GENETICS, EUGENICS, AND EVOLUTION (3)
Professor Wright

CERAMICS

PROFESSOR EDWARD C. HENRY, M.S., Cer.E., Ph.D.
Chief of the Division

500. CERAMICS SEMINAR (1 per semester) Conferences, reading, and reports. Required of all graduate students in ceramics. Prerequisites: Chem. 41, Phys. 285.
Professor Henry and Staff
501. CERAMICS RESEARCH (1-15 per semester) Laboratory study on special ceramic problems.
Professor Henry and Staff
502. HEAT TREATMENT OF CERAMIC MATERIALS (2-5) Effect of controlled heat treatment on physical and chemical properties of various mineral systems.
503. CONSTITUTION OF GLASS (2-4) Advanced course on glass dealing with latest developments in the structure of viscous liquids and transparent amorphous solids. Prerequisite: Cer. 415.
Professor Weyl
504. RESEARCH INSTRUMENTS AND EQUIPMENT (2) Applications of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations). Prerequisite: Cer. 411.
505. GLASS TECHNOLOGY RESEARCH (1-15 per semester) Laboratory studies on special problems concerning properties, constitution, and manufacture of glass. Prerequisite: Cer. 415.
Professor Weyl and Staff
506. GLASS TECHNOLOGY SEMINAR (1-6) Group discussion of special advanced topics concerning properties and manufacture of glass. Prerequisite: Cer. 415.
Professor Weyl and Staff
507. COLORING AND DECOLORIZING GLASS (1) Physical-chemical considerations of various coloring oxides; oxidation-reduction equilibria pertaining to coloring and decolorizing of glass. Prerequisite: Cer. 415.
Professor Weyl
508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Colloidal activity in bodies, glazes, and enamels, drilling fluids, filtering and bleaching clays, and similar mineral systems. (In co-operation with the Petroleum and Natural Gas staff.) Prerequisite: Chem. 41.
Professor Henry

509. **SILICATE SYSTEMS (3)** Properties of silica; classification of silicates; reactions in binary and ternary systems; industrial applications of the phase rule. Prerequisites: Chem. 41, Cer. 303. *Professor Matson*
510. **CERAMIC PROBLEMS (1-6 per semester)** Advanced individual study on a problem in some branch of ceramics, including review of the literature and a full report. Prerequisite: Cer. 411. *Professor Henry and Staff*
511. **SELECTED TOPICS IN CERAMICS (1-3 per semester)** Intensive group study of special subjects, such as diffusion in solids, viscosity, and kinetics of ceramic processes. Prerequisite: Chem. 41, Phys. 285. *Professor Henry and Staff*
512. **SYNTHESIS OF CERAMIC COMPOUNDS (3)** Advanced ceramic technology applied to the control of phases formed in commercial production of glass, whitewares, refractories, and cements. Prerequisites: Chem. 41, Cer. 303. *Professor Hummel*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. **SPECIAL TOPICS (1-2)**
401. **CERAMIC BODIES AND GLAZES (3)** *Professor Hummel*
402. **PRINCIPLES OF CERAMIC ENGINEERING (3)** *Professor Henry*
403. **CERAMIC ENGINEERING PROCESSES AND EQUIPMENT (3)** *Professor Ehman*
404. **CERAMIC SEMINAR (1)** *Professor Henry and Staff*
405. **CERAMIC RESEARCH AND DESIGN (3)** *Professor Henry and Staff*
411. **THEORY OF CERAMIC PROCESSES (2)** *Professor Hummel*
- 413, 413X. **CERAMIC PETROGRAPHY (3)** *Professor Matson*
415. **GLASS AND ENAMELS (3)** *Professor Ehman*
416. **ADVANCED GLASS TECHNOLOGY (3)** *Professors Weyl and Rindone*
420. **REFRACTORIES (3)** *Professor Matson*

CHEMICAL ENGINEERING

PROFESSOR DONALD S. CRYDER, M.S., D.Sc.

Head of the Department

500. **SEMINAR IN CHEMICAL ENGINEERING (1)** Required of all graduate students.
510. **ADVANCED HEAT TRANSFER I (3)** Physical and chemical factors controlling the rate of heat transfer under conditions of steady flow. *Professor Cryder*
511. **ADVANCED HEAT TRANSFER II (3)** Flow of heat under varying temperature conditions. *Professor Cryder*
515. **DISTILLATION (3)** Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns. *Professor Carnahan*
516. **ECONOMIC BALANCE (3)** Problem work on the design of chemical engineering equipment from the economic standpoint. *Professor Cannon*
518. **CHEMICAL ENGINEERING DESIGN (3)** Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. *Professor Cryder*

CHEMICAL ENGINEERING

524. CHEMICAL ENGINEERING, APPLICATION OF THERMODYNAMICS (3) Elements of thermochemistry and thermodynamics of greatest importance in chemical engineering. *Professor Cannon*
580. RESEARCH IN PETROLEUM REFINING (3-15) Charge will be made for supplies consumed and breakage of equipment. *Professors Fenske and Quiggle*
599. RESEARCH IN CHEMICAL ENGINEERING (1-15) Charge will be made for supplies consumed and breakage of equipment.
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
402. CHEMICAL ENGINEERING (4) *Professor Carnahan*
403. CHEMICAL ENGINEERING (4) *Professor Carnahan*
422. MOTOR FUELS (2) *Professor Carnahan*

CHEMISTRY

PROFESSOR W. CONARD FERNELIUS, M.A., Ph.D.
Head of the Department

500. SEMINAR IN INORGANIC CHEMISTRY (1)
501. SEMINAR IN PHYSICAL CHEMISTRY (1)
502. SEMINAR IN ORGANIC CHEMISTRY (1)
503. SEMINAR IN ANALYTICAL CHEMISTRY (1)
515. INORGANIC CHEMISTRY (2) Adapted to the needs of those desiring a general treatment of inorganic chemistry at an advanced level. *Professor Holtzinger*
516. SYSTEMATIC INORGANIC CHEMISTRY (3) Systematic treatment of inorganic chemistry in terms of modern concepts. *Professors Fernelius, Wartik, and Block*
517. CHEMISTRY OF THE LESS FAMILIAR ELEMENTS (3) Continuation of Chem. 516. *Professors Fernelius, Wartik, and Block*
518. SPECIAL TOPICS IN INORGANIC CHEMISTRY (3 per semester) Modern developments in specialized fields.
525. ANALYTICAL CHEMISTRY (3) Analytical principles as applied to analysis of inorganic and organic substances.
526. ADVANCED ANALYTICAL CHEMISTRY (3) Theory and practice of contemporary analytical chemistry as used in chemical research and plant operation.
527. SPECIAL TOPICS IN ANALYTICAL CHEMISTRY (2-12) Currently used techniques in analytical chemistry.
531. SPECIAL TOPICS IN ORGANIC CHEMISTRY (3) May be taken for credit for four successive semesters.
532. ORGANIC NITROGEN COMPOUNDS (3) Chemistry, stereochemistry, and molecular structure of organic compounds containing nitrogen. *Professor Aston*

534. THEORETICAL ORGANIC CHEMISTRY (3) Modern theories of structure; resonance; interpretation of physical properties; theory of rates; equilibrium properties.
Professor Aston
- 535-536. ORGANIC CHEMISTRY (3 each) Adapted to the needs of those doing research work in organic chemistry.
Professor Zook
538. ORGANIC CHEMISTRY (3) Survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry.
Professors Noll and Oakwood
539. STEREOCHEMISTRY (3) Comprehensive treatment of the principles of stereochemistry as applied to organic compounds.
Professor Oakwood
541. PHASE RULE (3) The phase rule and its applications. Given 1952-53 and in alternate years thereafter.
Professor Currier
542. COLLOIDS (3) The physics and chemistry of surfaces and their resulting colloid properties. Methods of preparing colloids.
Professor Smith
543. RHEOLOGY OF COLLOIDS (3) Continuation of Chem. 542. Rheology especially as applied to colloids and similar substances.
Professor Smith
544. CHEMICAL THERMODYNAMICS (3) Development of thermodynamic theory with special reference to common physical changes and chemical reactions. Prerequisite: Chem. 441 or 562.
Professor Aston
545. CHEMICAL THERMODYNAMICS AND INTRODUCTORY STATISTICAL MECHANICS (3) Continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544.
Professor Aston
546. QUANTUM CHEMISTRY (3) Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with special emphasis on the portion of the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Given alternate years only.
Professor Aston
547. STATISTICAL MECHANICS (3) Properties of matter at equilibrium, developed on the basis of energy levels of molecules and statistical mechanical theory. Prerequisite: Chem. 546. Given alternate years only.
Professor Aston
548. CATALYSIS (3) Theory of catalysis and its application to industry. Given 1953-54 and in alternate years thereafter.
Professor Currier
550. RESEARCH IN HOUSEHOLD CHEMISTRY (1-15) Charge will be made for supplies consumed and breakage of equipment.
- 561-562. CHEMICAL PRINCIPLES (3 each) Mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 41, Math. 11, Phys. 285. A course in organic chemistry is recommended.
Professors Seward, Fritz, Ascah, and Taft
563. CHEMICAL KINETICS (3) Theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions.
Professors Ascah and Taft
564. CHEMICAL KINETICS (3) Continuation of Chem. 563 but including theory and measurement of photochemical reactions.
Professor Ascah and Taft

CHEMISTRY

- 565-566. ATOMIC AND MOLECULAR STRUCTURE (3 each) Structure of chemical species and correlation of experimentally determined properties by structural theory.
- 567-568. ADVANCED THEORETICAL CHEMISTRY (3 each) Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory.
580. RESEARCH IN PETROLEUM REFINING (1-15) Charge will be made for supplies consumed and breakage of equipment. *Professor Fenske*
599. RESEARCH IN CHEMISTRY (1-15) Charge will be made for supplies consumed and breakage of equipment.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. CHEMICAL LITERATURE (1) *Miss Jackson*
- 411-412. FLUORINE CHEMISTRY (3 each)
413. INORGANIC PREPARATIONS AND LABORATORY METHODS (2-5) *Professor Block*
426. ADVANCED QUALITATIVE AND QUANTITATIVE ANALYSIS (3-5) Breakage ticket *Professor Hayes*
\$10.
434. QUANTITATIVE ORGANIC ANALYSIS (3-5) Breakage ticket \$10 for 3 credits, \$12 for 4 or 5 credits.
435. ORGANIC PREPARATIONS AND LABORATORY METHODS (3-5) Breakage ticket \$10 for 3 credits, \$12 for 4 or 5 credits. *Professor Oakwood*
436. ORGANIC CHEMISTRY OF NATURAL PRODUCTS (3) *Professor Aston*
437. QUALITATIVE ORGANIC ANALYSIS (3) Breakage ticket \$4. *Professors Olewine and Noll*
- 440-441. ADVANCED PHYSICAL CHEMISTRY (3 each) *Professors Hutchison and Seward*
448. COLLOID CHEMISTRY (3) Breakage ticket \$3. *Professor Hutchison*
- 453a-h. RECENT ADVANCES IN TEXTILE CHEMISTRY (1-8)
470. CHEMICAL MICROSCOPY (3) Breakage ticket \$2. *Professor Willard*
471. ADVANCED CHEMICAL MICROSCOPY (3) Breakage ticket \$2. *Professor Willard*
472. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$2. *Professor Fleming*
473. TEXTILE MICROSCOPY (3) Breakage ticket \$2. *Professor Willard*
474. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$2. *Professor Fleming*
475. INTRODUCTION TO CHEMICAL SPECTROSCOPY (3) Breakage ticket \$2. *Professor Schempf*
476. MICROSCOPIC MICROTECHNIQUE (3) Breakage ticket \$2. *Professor Willard*
477. PAPER MICROSCOPY (3) Breakage ticket \$2. *Professor Willard*
489. INTRODUCTION TO CHEMICAL RESEARCH (3-5)
- †490. ORGANIC CHEMISTRY (5) Breakage ticket \$4. *Professor Olewine*
- †491. ORGANIC CHEMISTRY (5) Breakage ticket \$12. *Professor Olewine*
- †492a. ADVANCED GENERAL CHEMISTRY (3) Breakage ticket \$3. *Professor Currier*
- †496. GENERAL PHYSICAL CHEMISTRY (3) *Professor Seward*
- †497. GENERAL PHYSICAL CHEMISTRY (3) *Professor Seward*
- †498. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket \$6. *Professor Ascah*
- †499. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket \$6. *Professor Ascah*

† Candidates for the M.Ed. degree.

CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS

PROFESSOR WINONA L. MORGAN, M.A., Ph.D.

Head of the Department

500. RESEARCH IN CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (1-6 per semester)

501. THESIS (1-15)

508. PARENTAL EDUCATION (3) Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: Ch.Fm. 429, 430. *Professor Morgan*

515, 515X. THE TEACHING OF CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (3) Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for Ch.Fm. 482. Prerequisite: 6 credits in child development and family relationships. *Professor Morgan*

529 (Psy. 529). SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisites: Ch.Fm. 429, 430, or Psy. 411, or 425. *Professor Morgan*

536. CHILDREN IN POSTWAR FAMILIES AND COMMUNITIES (3) Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: Ch.Fm. 429, 430, or 2 courses in psychology. *Professor Morgan*

545, 545X. THE FAMILY IN ITS COMMUNITY (2-3) Cultural influences on family relationships; how the family orients its members to community living and group participation. Prerequisites: Soc. 1, Ch.Fm. 405; R.Soc. 452 or Psy. 419. *Professor Smith*

546. SEMINAR IN FAMILY RELATIONSHIPS (1-3) Reading, reports, and discussion of recent research in relationship aspects of family living; particular attention to studies of roles, crises, and adjustments within the family setting. Prerequisite: Ch.Fm. 405 or 6 hours of sociology or psychology. *Professor Smith*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

405. MARRIAGE AND FAMILY RELATIONSHIPS (3) *Professor Smith*

429, 429X. CHILD DEVELOPMENT (3) *Professor Avery*

430. OBSERVATION AND EXPERIENCE IN NURSERY SCHOOL (1-5)

440, 440X. STUDY OF LATER CHILDHOOD (3) *Professor Avery*

441. NURSERY SCHOOL ORGANIZATION (3) *Professor Morgan*

445 (Psy. 445). DEVELOPMENT THROUGHOUT ADULTHOOD (3)

481. EDUCATIONAL METHODS WITH PRESCHOOL CHILDREN (3) *Professor Bovie*

482. EDUCATIONAL PROCEDURES IN CHILD DEVELOPMENT AND FAMILY RELATIONS (3) *Professor Morgan*

495S. FAMILY HEALTH AND HUMAN RELATIONS (3-9)

CIVIL ENGINEERING

PROFESSOR BENJAMIN A. WHISLER, M.S., Sc.D.
Head of the Department

500. SEMINAR IN CIVIL ENGINEERING (1-6) Reports on researches and special topics. Course may be continued in subsequent semesters.
521. TRANSPORT PLANNING AND DESIGN (2-6) Planning and design of transportation facilities; basic principles and engineering techniques applied to airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.
522. TRANSPORT OPERATION AND MAINTENANCE (2-6) Engineering problems in operation, maintenance, and administration of airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.
540. ADVANCED STRUCTURAL ANALYSIS (2-4) Geometry of flexure; deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C.E. 40.
541. ADVANCED STRUCTURAL ANALYSIS (2-4) Truss deflection; trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C.E. 40.
542. APPLIED SOIL MECHANICS (2-5) Soil classification by type of clay minerals and profile development; aerial photographic interpretation of soils and applications to site selection for dams, highways, and airports. Prerequisites: C.E. 412, 444, Geol. 71.
543. STRUCTURAL ENGINEERING PROJECTS (3-10) Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C.E. 441, 442.
544. ADVANCED STRUCTURAL DESIGN (2-4) Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisites: C.E. 42, 442.
545. ADVANCED STRUCTURAL DESIGN (2-4) Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C.E. 41.
550. ENGINEERING CONSTRUCTION (2-4) Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C.E. 41, 42.
551. HYDROLOGIC INVESTIGATIONS (2-8) Application of hydrologic principles and techniques to a specific project. Prerequisite: C.E. 451.
560. HYDRAULIC STRUCTURES (3) Hydraulic and structural considerations in design of dams, spillways, gates, canals and flumes, siphons, and locks. Prerequisite: C.E. 462.
562. ADVANCED FLUID MECHANICS (3) Euler's equations, potential theory, flow nets, conformal mapping, boundary layers, turbulence, compressibility, wave theory, flow of viscous fluids.

563. **HYDRAULICS RESEARCH (2-8)** Analytical or experimental study of a problem in hydraulics. Prerequisite: C.E. 462.
566. **FLUID MECHANICS OF HYDRAULIC MACHINERY (3)** Advanced theory and design of hydraulic machinery. Prerequisite: C.E. 466.
568. **THEORETICAL HYDRODYNAMICS (3)** Analysis of the irrotational motion of fluids in two and three dimensions, vortex motion, wave theory, theory of viscous fluids.
569. **RESEARCH IN FLUID DYNAMICS (1-8)** Analytical or experimental study of a problem in fluid dynamics. Prerequisite: C.E. 562.
570. **RURAL SANITATION DESIGN (3)** Requirements and devices essential to rural sanitary problems: water supply, excreta disposal, industrial waste treatment. Not intended for civil or sanitary engineering students. Prerequisites: Chem. 4, Phys. 285.
571. **WATER PURIFICATION AND SOFTENING (3)** Current methods of softening, disinfecting, and conditioning water for municipal and industrial use. Prerequisite: C.E. 70.
572. **SEWAGE TREATMENT (3)** Modern methods of sewage treatment. Prerequisite: C.E. 70.
573. **ADVANCED PROBLEMS IN SANITARY ENGINEERING (3-10)** Continuation of C.E. 474 on a graduate level. Prerequisite: C.E. 474.
575. **ADVANCED INDUSTRIAL WASTE TREATMENT (3)** Techniques of industrial waste treatment; attendant stream pollution and stream self-purification factors. Prerequisite: C.E. 472 or 572.
576. **WATER TREATMENT PLANT DESIGN (1-6)** Design of works for treatment of water for municipal and industrial use. Prerequisite: C.E. 71.
577. **SEWAGE TREATMENT PLANT DESIGN (1-6)** Design of works for treatment of sewage or industrial wastes. Prerequisite: C.E. 71.
578. **INDUSTRIAL HYGIENE (3)** Principles of control of industrial toxics and the protection of the worker and the community.
579. **PUBLIC HEALTH ADMINISTRATION (3)** Operation and duties of health departments at the various levels.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401a,b,c,d. **CIVIL ENGINEERING PROJECTS (2-12)**
412. **ADVANCED PHOTOGRAMMETRY (3)**
421. **HIGHWAYS AND STREETS (3)**
422. **RAILROADS (3)**
423. **HIGHWAY SAFETY AND TRAFFIC CONTROL (3)**
431. **CIVIL ENGINEERING CONSTRUCTION (3)**
441. **STATICALLY INDETERMINATE STRUCTURES (3)**
- 442, 442X. **STATICALLY INDETERMINATE STRUCTURES (3)**
443. **PHOTOELASTICITY AND MODEL ANALYSIS (3)**
- 444, 444X. **SOIL MECHANICS AND FOUNDATIONS (3)**

CIVIL ENGINEERING

- 446. ADVANCED SOIL MECHANICS (3)
- 451. ADVANCED HYDROLOGY (3)
- 462. ADVANCED HYDRAULICS (3)
- 463. HYDRAULIC LABORATORY INVESTIGATIONS (1-6)
- 465. APPLIED HYDRAULICS (3)
- 466. HYDRAULIC MACHINERY (3)
- 471. MUNICIPAL AND RURAL SANITATION (3)
- 472. SEWAGE AND INDUSTRIAL WASTES TREATMENT (3)
- 473. WATER AND SEWAGE ANALYSIS (3)
- 474. SANITARY ENGINEERING PROBLEMS (1-6)
- 475. WATER TREATMENT AND CONDITIONING (3)
- 481. MUNICIPAL PLANNING AND ZONING (3)

CLOTHING AND TEXTILES

PROFESSOR RUTH AYRES, A.M., Ph.D.
Head of the Department

- 500. RESEARCH IN CLOTHING OR TEXTILES (1-6 per semester)
- 501. THESIS (1-15)
- 502. TAILORING (3) Construction of tailored garments for women and children from new or renovated materials. Prerequisites: Cl.Text. 102, 201.
- 503. ADVANCED FITTING AND PATTERN STUDY (3) Application of principles involved in altering patterns and fitting garments to give students freedom in designing and ability to deal with difficult fitting problems. Prerequisite: Cl.Text. 201.
- 504. ADVANCED DRESS DESIGN (3) Draping of garments difficult in type and distinctive in design; survey of literature in dress design. Prerequisites: Art 56, Cl.Text. 404.
- 505, 505X. CLOTHING INSTRUCTIONAL MATERIALS (3) Preparation and evaluation of different types of materials for instruction in textiles and clothing. Prerequisite: Cl.Text. 201.
- 506. THE FASHION WORLD (3) Development of fashion throughout the ages; relationship of present-day fashions and practices with previous periods. Prerequisites: Cl.Text. 102, 301.
- 507. PROBLEMS IN RELATION TO CLOTHING CONSUMPTION (3) Problems connected with manufacture and consumption of clothing, interrelation of textile and clothing trades with other industries. Prerequisite: Cl.Text. 301.
- 508. SPECIAL PROBLEMS IN CLOTHING AND TEXTILES (1-6) Individual directed study, investigation, and practice in selected phases of textiles and clothing. Prerequisites: Cl.Text. 102, 201.
- 509. SEMINAR IN CLOTHING AND TEXTILES (1-6) Discussion and reports on current research in clothing and textiles.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401. CLOTHING CONSERVATION (2-3)
- 403. FITTING AND PATTERN ADJUSTMENT (3)
- 404. DRESS DESIGN (3)
- 405, 405X. FASHION MERCHANDISING (3)
- 406. FASHION PROMOTION OF TEXTILES AND CLOTHING (3)
- 407. THE TEXTILE AND CLOTHING INDUSTRY (3)
- 408. TEXTILES (3)
- 409, 409X. COSTUME SELECTION (3)

COMMERCE

PROFESSOR WILLIAM N. LEONARD, A.M., Ph.D.

Head of the Department of Economics and Commerce

- 500. CASE STUDIES IN BUSINESS ADMINISTRATION (3) Case studies of business and management policy with respect to procurement, production, selling, finance, accounting, relations with government, labor, and the public. *Professor Waters*
- 501. COMMERCE SEMINAR (3-6) Reports on research in selected fields of commercial activities.
- 505. PROBLEMS OF CORPORATION FINANCE (3) The more important current problems of corporate financial policy, particularly problems of promotion, capitalization, security issue, valuation, administration of income, expansion, reorganization, and government control of policy. Prerequisites: Com. 5, 41.
Professor Leffler
- 515. TRANSPORTATION RATES AND BUSINESS (3) Rate making and rate changes and their effects on business location and development. Prerequisite: Com. 15.
Professor Waters
- 517. INTERNATIONAL BUSINESS PRACTICES (3) Practices of exporters and importers dealing in commodities traded in world markets under competition, monopoly, or governmental control. Prerequisite: Com. 17.
Professor Hench
- 523. SEMINAR IN MARKETING (3) Research in modern marketing trends.
Professor Hilgert
- 524. MARKETING POLICIES (3) Major problems of sales planning, organization, control, and supervision; current trends in merchandising policies of manufacturers; selection and training of salesmen, preparation of selling methods, sales budgets and sales quotas. Prerequisite: Com. 424.
Professor Hilgert
- 525. CASE STUDIES IN INSURANCE (3) Analysis of management's insurance problems, such as the feasibility of self-insurance; proper allocation of insurance premiums and coverage in selected industries, etc. Prerequisites: Com. 25, 33.
Professor Wherry

COMMERCE

526. PROBLEMS OF ADVERTISING (3) Advertising budgeting, selection of media, appraisal of effectiveness, co-ordination of advertising and selling efforts. Prerequisite: Com. 23. *Professor Hilgert*
536. PROBLEMS IN SALES MANAGEMENT (3) Principles of sales planning and administration; co-ordination of selling with advertising, promotion, production, and accounting; use of market research selling costs and budgets. Prerequisite: Econ. 1. *Professor Hilgert*
540. ACCOUNTING SEMINAR (3) Selected phases of accounting theory. Prerequisite: Com. 43. *Professor Rowland*
548. ACCOUNTING SYSTEMS (3) Principles of system design including practical application to special businesses, such as financial institutions, department stores, public utilities, etc. Prerequisite: Com. 442. *Professor Rowland*
550. REAL ESTATE PROBLEMS (3) Analysis of current real estate problems and practices for broker, business man, and property owner; appraisal methods; property management; housing, and legal, financial, economic, and social aspects of the real estate field. Prerequisite: Com. 50.
560. CASE STUDIES IN AMERICAN INDUSTRIES (3) Economic relationship of such factors as climate, resources, population, transportation and markets, and location of enterprise. Prerequisite: Com. 60. *Professor Mares*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 401. PURCHASING (3) | <i>Professor Babione</i> |
| 402. CONTROLLERSHIP (3) | <i>Professor Nelson</i> |
| 405. ANALYSIS OF FINANCIAL STATEMENTS (3) | <i>Professor Cook</i> |
| 407. INVESTMENT BANKING (3) | <i>Professor Bradley</i> |
| 410. BANK MANAGEMENT (3) | <i>Professor McKinley</i> |
| 415. REGULATION OF TRANSPORT CARRIERS (3) | <i>Professor Waters</i> |
| 417. FOREIGN MARKETS (3) | <i>Professor Reedy</i> |
| 423. ADVERTISING PROCEDURE (3) | <i>Professor Decker</i> |
| 424. MARKETING RESEARCH (3) | <i>Professor Hilgert</i> |
| 425. INSURANCE AGENCY MANAGEMENT (3) | <i>Professor Wherry</i> |
| 426. STORE MANAGEMENT AND OPERATION (3) | <i>Professor Einstein</i> |
| 427. RETAIL BUYING AND MERCHANDISING (3) | <i>Professor Einstein</i> |
| 428. RETAIL ADVERTISING AND SALES PROMOTION (3) | <i>Professor Einstein</i> |
| 429. BUYING AND MERCHANDISING PROBLEMS (3) | <i>Professor Einstein</i> |
| 430. ADVANCED BUSINESS LAW (3) | <i>Professor Tanner</i> |
| 431. C. P. A. LAW REVIEW (3) | <i>Professor Tanner</i> |
| 436. FUNDAMENTALS OF SALES MANAGEMENT (3) | <i>Professor Hilgert</i> |
| 442. ADVANCED ACCOUNTING (3) | <i>Professor Devereaux</i> |
| 443. ADVANCED AUDITING (3) | <i>Professor Rowland</i> |
| 444. BUDGETARY CONTROL (3) | <i>Professor Nelson</i> |
| 445. ADVANCED COST ACCOUNTING (3) | <i>Professor Nelson</i> |
| 447. ADVANCED FEDERAL TAX ACCOUNTING (3) | <i>Professor Rowland</i> |
| 448. C. P. A. REVIEW COURSE (3) | <i>Professor Rowland</i> |
| 460. MANUFACTURING INDUSTRIES (3) | <i>Professor Mares</i> |
| 470. PUBLIC RELATIONS IN BUSINESS (3) | <i>Professor Wherry</i> |
| 475. BUSINESS MANAGEMENT (3) | <i>Professor Stonier</i> |

COMMERCIAL CONSUMER SERVICES

PROFESSOR MARY BROWN ALLGOOD, M.S.

Chairman of the Division

The following courses may be taken for graduate credit under the restrictions in force:

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| 403. LECTURE-DEMONSTRATION TECHNIQUES (3) | <i>Professor Allgood</i> |
| 450. PROBLEMS IN HOUSEHOLD EQUIPMENT (1-6) | <i>Professor Allgood</i> |

COMPARATIVE LITERATURE

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.

Chairman of the Committee in Charge

500. SEMINAR IN COMPARATIVE LITERATURE (3-6)

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

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| 400. COMPARATIVE METHOD IN LITERARY STUDIES (3) | |
| 480. INTRODUCTION TO FOLKLORE (3) | <i>Professor Bayard</i> |

DAIRY HUSBANDRY

PROFESSOR DONALD V. JOSEPHSON, M.S., Ph.D.

Head of the Department

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| 501. BUTTER AND CHEESE (1-6) | Manufacture and handling of butter and cheese. | |
| Prerequisites: D.H. 10, 23, Bact. 8, A.B.Ch. 403. | | <i>Professor Dahle</i> |
| 502. CONDENSED MILK AND MILK POWDER (1-6) | Condensing and drying of milk. | |
| Prerequisites: D.H. 10, 26, Bact. 8, A.B.Ch. 403. | | <i>Professor Doan</i> |
| 503. PUBLIC MILK PROBLEMS (1-6) | Handling milk in modern plants. | |
| Prerequisites: D.H. 11, Bact. 8, A.B.Ch. 403. | | <i>Professor Doan</i> |
| 504. ICE CREAM MANUFACTURE (1-6) | Manufacture of ice cream, ices, and other frozen milk products. | |
| Prerequisites: D.H. 11, Bact. 8, A.B.Ch. 403. | | <i>Professor Dahle</i> |
| 505. DAIRY PLANT ECONOMICS (1-6) | Economic factors involved in creamery operation and management. | |
| Prerequisites: D.H. 7, 11. | | <i>Professor Dahle</i> |
| 506. DAIRY CATTLE BREEDING (1-6) | Improvement of dairy cattle, including methods of sire evaluation, systems of breeding, and development of breeding programs. | |
| Prerequisite: D.H. 30. | | <i>Professor Almquist</i> |
| 507. DAIRY CATTLE MANAGEMENT (1-6) | Management of dairy cattle. | |
| Prerequisite: D.H. 27. | | <i>Professor Williams and Staff</i> |

DAIRY HUSBANDRY

508. DAIRY SEMINAR (1-6) Preparation and presentation of a paper on an assigned subject. *Professor Josephson and Staff*
509. TESTING DAIRY PRODUCTS (1-6) Constituents of dairy products. Prerequisites: D.H. 11, Bact. 8, A.B.Ch. 403. *Professor Doan*
510. DAIRY CATTLE FEEDING (1-6) Application of fundamental research in animal nutrition to the feeding of dairy cattle. Prerequisites: D.H. 1, 29. *Professor Williams*
511. DAIRY CATTLE NUTRITION (1-6) Nutritional requirements of dairy cattle. Prerequisites: A.Ntr. 401, 402. *Professor Knodt and Staff*
512. ADVANCED STUDIES IN MILK SECRETION (1-6) Physiology of milk secretion. Prerequisite: D.H. 427. *Professor Knodt*
513. DAIRY CATTLE SELECTION (1-6) Breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.H. 1, 30. *Professor Knodt and Staff*
515. ADVANCED PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (1-6) Reproduction of farm animals. *Professor Almquist*
516. ARTIFICIAL BREEDING OF FARM ANIMALS (1-6) Prerequisite: D.H. 431. *Professor Almquist*
517. DAIRY HUSBANDRY LITERATURE (1-6) Review and reporting of dairy literature. *Professor Josephson and Staff*
518. THESIS (1-15) *Professor Josephson and Staff*
519. RESEARCH IN DAIRY PRODUCTION (1-15 per semester) *Professor Josephson and Staff*
520. RESEARCH IN DAIRY MANUFACTURING (1-15 per semester) *Professor Josephson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

418. DAIRY SURVEY (1) *Professor Josephson*
421. DAIRY MANUFACTURING PROBLEMS (1-6) *Professors Dahle, Doan, and Staff*
427. MILK SECRETION (3) *Professor Knodt*
428. DAIRY PRODUCTION PROBLEMS (1-3) *Mr. Dawdy and Staff*
429. TESTING DAIRY PRODUCTS (1-6) *Mr. Davey*
430. TECHNICAL CONTROL OF DAIRY PRODUCTS (4) *Professor Watrous*
431. PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (3) *Professor Almquist*

DRAMATICS

Consult PROFESSOR ARTHUR C. CLOETINGH, M.A.

501. PROBLEMS OF DIRECTING (3-6) Seminar in problems of production with particular stress on direction. Students will direct plays under staff supervision.

502. SEMINAR IN THE TECHNICAL PROBLEMS OF DRAMATIC PRODUCTION (3-6) Prerequisite: Dram. 11.
503. ART OF DRAMATIC LIGHTING (3) Seminar in stage lighting; advanced study in the theory of lighting as used for dramatic effectiveness. Practical work required of each student. Prerequisite: Dram. 12.
504. SEMINAR IN STYLES OF ACTING (3-6) Practical work required of each student.
506. EVALUATION AND APPRECIATION OF MODERN DRAMATIC ENTERTAINMENT (3) Prerequisites: Dram. 1, 61.
507. SEMINAR IN FUNDAMENTAL THEORIES OF THEATER AND DRAMA (3-6)
521. PLAYWRITING (3-6) Prerequisites: Dram. 21, 421.
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
403. ADVANCED MAKE-UP (1)
404. STYLES OF ACTING (3)
411. TECHNICAL PRODUCTION (3)
412. ADVANCED SCENE DESIGN (3)
413. ADVANCED STAGE LIGHTING (3)
421. ADVANCED PLAYWRITING (3)
431. HISTORY OF THE THEATER (3)
- 442S. EDUCATIONAL DRAMATICS (3)
- 443S. EDUCATIONAL DRAMATICS (ADVANCED MARIONETTES) (3)
451. DIRECTING (3)
452. CENTRAL STAGING (3)
470. DRAMATICS IN THE SCHOOLS (3)
480. RADIO DRAMA (3)
481. ADVANCED RADIO DRAMA (3)

ECONOMICS

PROFESSOR WILLIAM N. LEONARD, A.M., Ph.D.
Head of the Department of Economics and Commerce

500. ECONOMICS SEMINAR (3-6)
501. RESEARCH METHODS IN ECONOMICS (3-6) *Professor Leonard*
502. VALUATION OF PUBLIC UTILITIES (3) *Professor Cook*
505. TRANSPORTATION SEMINAR (3) Prerequisite: Com. 15. *Professor Waters*
507. INTERNATIONAL ECONOMIC RELATIONS (3) *Professor Hench*
508. SEMINAR IN MONEY AND BANKING (3-6) Prerequisite: Econ. 51. *Professor McKinley*
509. TAXATION PROBLEMS (3) *Professor Stout*
510. DEMAND ANALYSIS (3) *Professor Mendelson*

ECONOMICS

511. ECONOMIC BASES FOR CONTROL OF INDUSTRIAL DISPUTES (3) Prerequisites: Econ. 1 or 14; 15. *Professor Myers*
515. LABOR SEMINAR (3) *Professor Reede*
520. ADVANCED ECONOMIC STATISTICS (3) Prerequisites: 6 credits in economics and 3 in statistics. *Professor Saylor*
522. ADVANCED ECONOMIC THEORY (3) Theory of price and allocation of scarce resources in production of goods and services demanded. Prerequisites: Econ. 2, 405. *Professor Mendelson*
523. ADVANCED ECONOMIC THEORY (3) Theory of income determination (national income) as a method of explaining variations in "output as a whole." Prerequisite: Econ. 522. *Professor Mendelson*
542. SEMINAR IN PUBLIC POLICY AND ECONOMIC STRUCTURE (3-6) *Professor Leonard*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. HISTORY OF ECONOMIC THOUGHT (3) *Mr. Levinson*
401. EUROPEAN ECONOMIC THOUGHT (3)
405. INTERMEDIATE ECONOMIC THEORY (3) *Professor Fouraker*
407. AMERICAN ECONOMIC THOUGHT (3)
409. THEORY OF INTERNATIONAL TRADE (3) *Professor Reedy*
410. ECONOMICS OF CONSUMPTION (3) *Professor Lee*
411. ECONOMICS OF LABOR RELATIONS (3) *Professor Myers*
412. ECONOMICS OF COLLECTIVE BARGAINING (3) *Professor Myers*
415. SOCIAL INSURANCE (3) *Professor Reede*
416. MANAGEMENT OF LABOR RELATIONS (3)
417. INTERNATIONAL COMMERCIAL POLICIES (3) *Professor Reedy*
418. ECONOMICS OF WAGES AND EMPLOYMENT (3) *Professor Belfer*
419. CASE STUDIES IN LABOR-MANAGEMENT RELATIONS (3) *Professor Reede*
421. CENTRAL AND INTERNATIONAL BANKS (3) *Professor McKinley*
423. PENNSYLVANIA LOCAL FINANCE (3) *Professor Stout*
424. PENNSYLVANIA STATE FINANCE (3) *Professor Stout*
425. THE MONEY MARKET (3) *Professor McKinley*
426. FISCAL POLICY (3) *Professor Levin*
427. MONETARY THEORY AND POLICY (3)
430. NATIONAL PLANNING (3) *Professor Keyes*
431. HOUSING AND COMMUNITY DEVELOPMENT (3) *Professor Keyes*
433. INTERNATIONAL MONETARY ECONOMICS (3) *Professor Reedy*
435. PROBLEMS OF FEDERAL FINANCE (3) *Professor Stout*
440. ECONOMIC INSTITUTIONS OF CAPITALISM (3) *Mr. Levinson*
450. THE BUSINESS CYCLE (3) *Professor Proctor*
460. LOCATION OF ECONOMIC ENTERPRISE (3) *Professor Mares*
480. MATHEMATICAL ECONOMICS (3) *Professor Mendelson*
490. MEASUREMENT OF THE ECONOMY (3) *Professor Saylor*
491. ADVANCED BUSINESS STATISTICS (3) *Professor Saylor*
492. DEMOGRAPHIC STATISTICS (3) *Professor Saylor*
- 499X. FOREIGN STUDY IN ECONOMICS (2-6)

EDUCATION

PROFESSOR CHARLES M. LONG, M.A., D.Ed.

Head of the Department

501. INTRODUCTION TO THE ADVANCED STUDY OF EDUCATION (1-3) Methods of educational research; criticism of studies and theses in education; initiating research projects; summarizing results of research. Prerequisite: Ed. 470 or Psy. 415.
Professor Davison
502. SUPERVISED EXPERIENCE IN STUDENT COUNSELING (3) Practice in the application of guidance principles and methods to cases counseled under supervision; case conferences; seminar in guidance techniques. Prerequisite: Ed. 453.
Professor Wellington
503. SUPERVISION OF GUIDANCE WORKERS (3) Practical experience in supervising and evaluating work of counselors. Prerequisite: Ed. 502. *Professor Wellington*
504. ORGANIZATION AND ADMINISTRATION OF GUIDANCE PROGRAMS (3) Principles, organization, personnel, functions, integration with school program, evaluation.
Professor Wellington
505. OCCUPATIONAL AND EDUCATIONAL INFORMATION (3) Occupational information for guidance purposes, educational information related to vocational choice and preparation. Prerequisite: Ed. 453. *Professor Wellington*
506. DEVELOPING ANALYSES OF THE INDIVIDUAL FOR VOCATIONAL COUNSELING (3) Collection and use of data basic to the counselor's understanding of individuals; the counseling interview and techniques other than testing.
Professor Wellington
510. INTERNSHIP IN PROFESSIONAL EDUCATION (1-9) Internship to take place in schools or educational situations where not regularly employed under supervision of graduate faculty.
- Unit A. Administration and Supervision (1-6)*
Unit B. College Teaching (3-6)
Unit C. Public School Research (3-6)
Unit D. Elementary Teaching (3-6)
Unit E. Secondary Teaching (3-6)
Unit F. Art Teaching and Supervision (3-6)
Unit G. Business Education Supervision (3-6)
Unit H. Special Education Supervision (3-6)
Unit I. Audio-Visual Education (3-6)
515. COMPARATIVE EUROPEAN EDUCATION (3) Educational policies and practices in school systems in western and central European nations. Prerequisite: Psy. 14.
Professor Champlin
516. SOCIAL FOUNDATIONS OF THE CURRICULUM (2-4) Analysis of societal needs as a basis for educational programs; contributions of public education to social advancement. Prerequisites: Ed. 25, Psy. 14. *Professor McNerney*
517. EVOLUTION OF EDUCATIONAL THOUGHT (2-3) Rise of formal educational

philosophy from Plato to John Dewey; preliminary reference to Chinese, Hindu, Chaldean, Persian, Hebrew, and Egyptian theories. *Professor Champlin*

522. PRODUCTION OF EDUCATIONAL MOVING PICTURES (1-3) Nonlaboratory course on production techniques from the sponsor's viewpoint; script writing; photography, editing, sound recording. Prerequisites: Ed. 424, 487 (Unit B). Conference 1 hour, alternate weeks by appointment. *Professor VanderMeer*

523. LABORATORY IN ORGANIZATIONAL ASPECTS OF MATERIALS OF INSTRUCTION (1-3) Organizing, storing, circulating, and maintaining instructional materials in an instructional materials library. Prerequisites: Ed. 424, 585. Conference 1 hour, alternate weeks by appointment. *Professor VanderMeer*

524. SEMINAR IN CURRICULUM MATERIALS AND THEIR UTILIZATION (3) Advanced detailed analysis of mass communication media; relationships among these and educational objectives, individual differences in learners, and ideas to be communicated. Prerequisites: Ed. 424, 585, 6 credits in educational psychology. *Professor VanderMeer*

525. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3) Study of science supporting dynamic instruction; principles of teaching as guides; analysis of modern procedures; understanding of learning; substance versus plans. Prerequisite: 12 semester hours of undergraduate work in education. *Professor Butler*

527. PROBLEMS IN THE EDUCATION OF THE MENTALLY RETARDED (1-4) Study of existing curriculums, instructional practices, educational programs; experimentation in curriculum building and materials construction. Prerequisites: Ed. 426 or 583, Unit P, and Ed. 427 and teaching experience. *Professor Neuber*

529. PROBLEMS IN THE EDUCATION OF THE MENTALLY GIFTED (1-4) Analysis of educational needs of mentally gifted; curriculum construction and curricular materials. Prerequisites: teaching experience and Ed. 426 or 583, Unit P, and 429. *Professor Neuber*

532. SUPERVISION OF STUDENT TEACHERS (3) A course in supervision for master teachers, department heads, and college teachers with supervisory responsibilities in teacher education. Prerequisite: experience in teaching and 18 credits in education, including at least 5 in methods. *Professor Moyer*

534a. READING CLINIC PRACTICE: ANALYSIS OF READING DISABILITIES (1-9) A laboratory course consisting of analysis of extreme reading disabilities and recommended remedial procedures; experience in preparation of case reports. Prerequisite: Ed. 432g or Psy. 550.

534b. READING CLINIC PRACTICE: REMEDIAL PROCEDURES (1-9) Practicum in special classes for reading disabilities; corrective and remedial procedures; specific procedures for correction of various types of reading disabilities. Prerequisite: Ed. 432g or 534a.

535. SEMINAR ON READING INSTRUCTION (2-12) Designed to appraise significant researches and to outline procedures and materials for research; reading readiness, word perception, basic reading skills, vocabulary development. Prerequisite: Ed. 432b or 432c. *Professor G. E. Murphy*

536. READING CLINIC RESEARCH (1-15) Prerequisites: Ed. 432b; or Ed. 432c, 432g. *Professor G. E. Murphy*

540. PROBLEMS OF ELEMENTARY EDUCATION (2-3) Problems seminar for experienced educators. Prerequisite: 12 credits in education and psychology, including 6 in elementary education.
Professor Long

541. SEMINAR IN CONTEMPORARY ISSUES IN ELEMENTARY EDUCATION (1-3) Conferences and discussions designed to meet the needs of experienced teachers and principals in the field of elementary education. Prerequisite: 6 credits in elementary education and teaching experience.

546. ELEMENTARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3)

548. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3) Principles underlying curriculum construction. Primarily for elementary education majors. Prerequisite: Ed. 31 or teaching experience.

550. PROBLEMS IN MODERN SECONDARY EDUCATION (1-4) Historical, psychological, social, and economic factors influencing secondary education; required as basic course of all graduate students in secondary education. Prerequisite: secondary school teaching.
Professor Butler

551. SEMINAR IN CONTEMPORARY ISSUES IN SECONDARY EDUCATION (2-9)
Professor McNerney

Unit A. The Secondary School Curriculum (2-3) Principles and philosophy of curriculum construction. Each student works out an individual problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience.

Unit B. Laboratory Studies in Application of Educational Method (2-3) Analysis and application of outstanding studies in secondary education; integration of results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.

Unit C. Organization and Administration of Secondary Education (2-3) Problems in reorganization of secondary education, with particular reference to philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology, and teaching experience.

556. THE SECONDARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3) Improvement of instruction; improvement of teachers in service; evaluation of teaching procedures; methods of supervision; selection and use of textbooks. Prerequisite: three years' teaching experience.

561. THE COMMUNITY COLLEGE AND POST-SECONDARY SCHOOL EDUCATION (2-3) Philosophy, organization, and character of school programs needed to meet educational needs of individuals who desire to continue their education on the post-secondary school level. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience.
Professors Patrick and Ehmann

562. THE INSTRUCTIONAL PROGRAM IN COMMUNITY COLLEGES AND POST-SECONDARY EDUCATION (2-3) Course offerings, curriculums, instructional materials and procedures, guidance, extracurricular activities, student personnel, evaluation of results, and faculty qualifications. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience.
Professors Patrick and Ehmann

EDUCATION

563. THE PROFESSIONAL EDUCATION OF TEACHERS (3) Development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff. Prerequisite: 6 credits in advanced courses in education and a course in educational psychology.
564. RECENT TRENDS IN HIGHER EDUCATION (2-3) Factors affecting current college enrollment, organization, administration, support, and curriculums, with special emphasis on general education, its development, aims, and forms.
Professor Ehmann
565. THE PRINCIPLES OF COLLEGE TEACHING (2-3) Principles involved in teaching at the college level; effective use of teaching aids; criteria used in evaluation.
566. STUDENT PERSONNEL PROGRAMS AT THE COLLEGE LEVEL (2-3) Student personnel services in higher education; organization of student advisory programs; use of personnel data; co-curricular activities; student welfare.
567. GROWTH AND ORGANIZATION OF HIGHER EDUCATION (2-3) Growth of higher education; influence of church, state, federal government; educational, social, and economic factors that have affected curriculums and organization of institutions.
Professor Ehmann
568. CURRICULUMS IN HIGHER EDUCATION (2-3) Various types of curriculums and philosophies underlying them; ways in which curriculums are developed; elective versus required courses; evaluation of achievement. *Professor Ehmann*
569. SEMINAR IN COLLEGIATE EDUCATION (1-6) Special topics in higher education. Prerequisite: Ed. 567.
Professor Weaver
574. ADVANCED EDUCATIONAL STATISTICS (2-4) Appropriate measures and devices for experimental research in education including correlation measures, curve fitting, and analysis of variance. Prerequisite: 12 credits of graduate work in education including Ed. 470 or Psy. 415.
Professor Davison
575. ADMINISTRATION AND SUPERVISION IN BUSINESS EDUCATION (3) Work of administrators, supervisors, and others responsible for improvement of instruction in business education; use of vocational testing; job analysis. Prerequisite: 6 credits in secondary education.
Professors Gemmell and Veon
576. INTRODUCTION TO RESEARCH IN BUSINESS EDUCATION (3) Methods of research in business education; opportunity to compile annotated bibliographies on current problems; analysis and evaluation of significant research. *Professor Gemmell*
577. EVALUATION OF RESEARCH AND EMPIRICAL LITERATURE IN BUSINESS EDUCATION (3) Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576.
Professor Gemmell
578. SEMINAR IN BUSINESS EDUCATION (3) Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577.
Professor Gemmell
580. SEMINAR IN SCHOOL ADMINISTRATION (1-6) Efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, stimulating co-operative work. Prerequisite: Ed. 480, 6 credits of Ed. 583.
Professor Aurand

582. **EDUCATIONAL SURVEY TECHNIQUES (2-3)** Methods for appraisal of an educational program; planning for expansion, consolidation, or reduction of educational offerings. Prerequisites: Ed. 480, 6 credits of Ed. 583. *Professor Davison*

583. **PROBLEMS IN ADMINISTRATION AND SUPERVISION (2-25)** Prerequisite: Ed. 480 or teaching or administrative or supervisory experience.

Professor Aurand and Staff

Unit A. The Educational Plant (2-3)

Unit B. Public Relations for School Administrators (2-3)

Unit C. Public School Finance (2-3)

Unit F. State and National Education Programs (2-3)

Unit I. Administration of Adult Education in the Public Schools (3)

Unit M. Legal Aspects of School Administration (3)

Unit P. The Administration of Public School Education for Atypical Children (2)

Unit Q. Dynamic Factors in School Administration (2-3)

Unit R. Public School Business Administration (2-3)

585. **CURRICULUM CONSTRUCTION (2-3)** Functions of administrators, supervisors, teachers, pupils, laymen in curriculum building to meet pupil and community needs. *Professor McGarey*

586. **PRINCIPLES OF SCHOOL SUPERVISION (2-3)** Organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests and teacher rating. Prerequisites: 18 credits in education and 3 years' teaching experience. *Professor McNerney*

587. **THE SECONDARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-4)** Problems of schedule making, teachers' meetings, curriculum making and revision, organization of extracurricular and guidance programs. Prerequisite: teaching experience.

589. **THE ELEMENTARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-3)** Duties of the elementary school principal in organizing and administering his school. Prerequisite: Ed. 442.

590. **PHILOSOPHY OF EDUCATION (2-4)** Fundamental principles; scientific sanctions of progressive instructional practices and professional experiences as bases for formulation of the educational creed. Prerequisite: 18 credits in education.

Professor Champlin

591. **EDUCATION IN RUSSIA, ASIA, AND THE MIDDLE EAST (2-3)** Current educational activities in Soviet Russia and other eastern European countries; the Middle East, North Africa, and the Far East.

592. **EDUCATION IN THE LATIN-AMERICAN COUNTRIES (2-3)** Recent educational progress in Central and South America, with special reference to Mexico, Cuba, Puerto Rico, Brazil, Chile, and Argentina.

594. **SEMINAR IN EDUCATION (1-3)** Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: 12 credits of graduate work in education. *Professors Long and Davison*

595. **EDUCATIONAL RESEARCH (1-9)** An inductive research from primary sources expected to maintain standards sufficiently high to warrant publication of the findings. Prerequisite: at least 6 hours of graduate study in education, including some work in statistics.

EDUCATION

597S. WORKSHOP IN CURRENT EDUCATIONAL PROBLEMS (1-6) For administrators, supervisors, experienced elementary and secondary teachers, guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Prerequisite: 12 credits of graduate work in education.

599. THESIS (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 413, 413X. HISTORY OF EDUCATION IN THE UNITED STATES (2-3) *Professor Champlin*
 415S, 415X. MODERN TENDENCIES IN AMERICAN EDUCATION (1-6)
 416X. SOCIAL EDUCATION (3)
 421X. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)
 424, 424X. VISUAL AND OTHER SENSORY AIDS FOR TEACHERS (1-3)
Professor VanderMeer
 425S, 425X. THE SCIENTIFIC DIRECTION OF LEARNING ACTIVITIES (2-4)
 426, 426X. EDUCATION OF EXCEPTIONAL CHILDREN (2-3) *Professor Neuber*
 427. EDUCATION OF THE MENTALLY RETARDED (2-3) *Professor Neuber*
 428, 428X. ADULT EDUCATION: ORGANIZATION, TYPES, AND METHODS (1-3) Units
 A, B, C. *Professor Cologne*
 429, 429X. EDUCATION OF THE MENTALLY GIFTED CHILD (1-3) *Professor Neuber*
 430, 430X. VISUAL AND OTHER AIDS IN SAFETY EDUCATION (3)
 431, 431X. PRINCIPLES AND METHODS OF TEACHING SAFETY EDUCATION (3)
 432b, 432bX. THE ELEMENTARY SCHOOL READING PROGRAM (2-3)
Professor G. E. Murphy
 432c, 432cX. READING PROBLEMS IN THE SECONDARY SCHOOL (2-3)
Professor G. E. Murphy
 432d, 432dX. SPECIAL PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL ENGLISH (2-3)
Professor G. E. Murphy
 432eX. CHORAL SPEAKING (3) *Professor G. E. Murphy*
 432f, 432fX. TEACHING SECONDARY SCHOOL ENGLISH (2-3) *Professor G. E. Murphy*
 432g, 432gX. READING DISABILITIES (2-3) *Professor Hunt*
 432h, 432hX. TECHNIQUES IN REMEDIAL READING (2-6) *Professor Hunt*
 433e. ADVANCED THEORY OF KINDERGARTEN (3) *Professor Graffius*
 433f, 433fX. TEACHING CHILDREN'S LITERATURE (2-3) *Professor G. E. Murphy*
 433h, 433hX. PROBLEMS OF ELEMENTARY SCHOOL ARITHMETIC (2-3)
Professor Neuber
 433n, 433nX. TEACHING SOCIAL STUDIES IN THE ELEMENTARY GRADES (2-3)
Professor Taylor
 433w, 433wX. TEACHING SOCIAL STUDIES IN THE HIGH SCHOOL (2-3)
Professor VanderMeer
 433y, 433yX. TEACHING MATHEMATICS IN THE SECONDARY SCHOOL (3)
 435X. EDUCATION FOR CITIZENSHIP (2-3) *Professor Champlin*
 438, 438X. TEACHING SCIENCE IN SECONDARY SCHOOLS (2-3) *Professor Free*
 438e, 438eX. TEACHING SCIENCE IN THE ELEMENTARY SCHOOL (1-3) *Professor Elzey*
 439, 439X. TEACHING TRAFFIC SAFETY AND AUTOMOBILE OPERATION (1-3)
Professor Neyhart, Mr. Intorre
 441X. PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS (2-3)
 442, 442X. ELEMENTARY EDUCATION (2-3)
 446. DIAGNOSIS OF ATTAINMENT (3)
 448X. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3)

EDUCATION

- 449aS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3) *Professor Free*
- 449bS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3) *Professor Free*
- 450X. SECONDARY EDUCATION (2-3) *Professor Butler*
- 451X. SPECIAL PROBLEMS OF THE HIGH SCHOOL TEACHER (2-3)
- 453, 453X. GUIDANCE PRINCIPLES AND PRACTICES (3)
- 454, 454X. EXTRACURRICULAR ACTIVITIES IN THE JUNIOR AND SENIOR HIGH SCHOOL (2-3) *Professors Moyer and Patrick*
- 456, 456X. PRINCIPLES AND PROBLEMS IN BUSINESS EDUCATION (1-3) *Professors Gemmell and Veon*
- 459, 459X. IMPROVEMENT OF INSTRUCTION IN BUSINESS SKILL SUBJECTS (1-3) *Professor Gemmell*
460. CURRICULUMS IN BUSINESS EDUCATION (3) *Professor Gemmell*
461. IMPROVEMENT OF INSTRUCTION IN BASIC BUSINESS SUBJECTS (3) *Professor Gemmell*
462. TEACHING SHORTHAND AND TYPEWRITING (3) *Professor Gemmell*
463. TEACHING OF BOOKKEEPING (3) *Professors Gemmell and Veon*
464. METHODS OF TEACHING DISTRIBUTIVE EDUCATION (3)
466. TEACHING OF OFFICE PRACTICE (3) *Professor Veon*
467. TEACHING OF SHORTHAND (2-3) *Professor Veon*
468. TEACHING OF TYPEWRITING (2-3) *Professor Veon*
- 470, 470X. EDUCATIONAL MEASUREMENTS (2-3) *Professor Davison*
- 474, 474X. TEACHING AND GROUP GUIDANCE ABOUT OCCUPATIONS (3)
- 480, 480X. EDUCATIONAL ADMINISTRATION (2-3) *Professors Miller and Remaley*
- 482X. SUPERVISION AND IMPROVEMENT OF INSTRUCTION (2-3)
- 485X. CURRICULUM CONSTRUCTION (2-3)
- 487, 487X. PROBLEMS IN VISUAL AND OTHER SENSORY AIDS IN EDUCATION (1-14)
Unit A (1-3), Unit B (2-3), Unit C (3), Unit D (1-2), Unit E (3) *Professor VanderMeer*
- 490X. PHILOSOPHY OF EDUCATION (3) *Professor Champlin*
- 491X. SCHOOL LAW (3)
- 493, 493X. CHARACTER EDUCATION AND GUIDANCE (2-3) *Professor Champlin*
494. RELIGIOUS EDUCATION (2-3)
- 495S. FAMILY HEALTH AND HUMAN RELATIONS (3-9)
- 497S, 497X. WORKSHOP IN SELECTED STUDIES IN ELEMENTARY AND SECONDARY EDUCATION (1-6)
- 498, 498X. PRACTICUM IN THE EDUCATION OF ATYPICAL CHILDREN (3-6) Unit A (3), Unit B (3), Unit C (3), Unit D (3), Unit E (3)
- 449, 499X. PROBLEMS OF SPECIAL EDUCATION (3) *Professor Neuber*

ELECTRICAL ENGINEERING

PROFESSOR ARTHUR H. WAYNICK, M.S., Sc.D.
Head of the Department

520. SEMINAR (1) Required of all graduate students in electrical engineering. Conferences, reading, and presentation of technical papers.
- 521a,b,c,d. ALTERNATING-CURRENT THEORY (2-12) Special problems in alternating-

ELECTRICAL ENGINEERING

current theory and application of these problems to alternating-current circuits or machinery at any frequencies.

523. TRANSIENTS IN LINEAR SYSTEMS (3) Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E.E. 423. *Professor Holt*

524. ENGINEERING ELECTRONICS (3) Special problems dealing with design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program. *Professor Stavely*

525. SYMMETRICAL COMPONENTS (3) Polyphase circuits and machines under unbalanced conditions of operation including effects of rotating machines upon distribution and transmission system performance; characteristics of phase converters and single-phase operation of polyphase systems. Prerequisite: E.E. 425. *Professor Holt*

528. SERVOMECHANISMS (3) Advanced treatment of transient and steady-state behavior of closed-cycle control systems with special attention to stability and design of stabilizing controllers. Prerequisite: E.E. 428. *Professor Tarpley*

530. AUDIO FREQUENCY ENGINEERING (3) Electrical systems and equipment used in production, recording, amplification, transmission, and measurement of sound. Prerequisite: E.E. 11 or 13. *Professor Hall*

531a,b,c. RADIO FREQUENCY ENGINEERING (3-9) Radio frequency equipment, measurements, and systems; amplifiers, modulators, demodulators, transmitters, receivers, transmission lines, antennae, and radiators. Prerequisite: E.E. 440. *Professor Hall*

532. ULTRA-HIGH-FREQUENCY ENGINEERING (4) Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E.E. 432. *Professor Hall*

533. AUTOMATIC CONTROL SYSTEMS (2-3) Automatic control, telemetering, and recording of electrical, mechanical, thermal, and chemical quantities. Prerequisite: E.E. 4. *Professor Rice*

535. ENGINEERING ANALYSIS (3) Engineering applications of complex variables, conformal mapping methods and potential plotting. Laplace transform methods and stability criteria. Prerequisite: E.E. 435. *Professor Davids*

538. ELECTROMAGNETIC ENGINEERING (3) Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E.E. 438. *Professor Van Meter*

550. COMMUNICATION NETWORKS (3) Methods of filter design using lattice networks; effects of dissipation on characteristics of filter networks; transient response of networks and design of equalizers. Prerequisite: E.E. 450. *Professor Tarpley*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

421a,b,c,d. ELECTRICAL ENGINEERING PROBLEMS (2-12)

ELECTRICAL ENGINEERING

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| 423. TRANSIENT PHENOMENA (3) | Professor Holt |
| 424. ENGINEERING ELECTRONICS (3) | Professor Shields |
| 425. SYMMETRICAL COMPONENTS (3) | Professor Holt |
| 428, 428X. SERVOMECHANISMS (3) | Professor Tarpley |
| 432. ULTRA-HIGH-FREQUENCY TECHNIQUES (3) | Professor Hall |
| 434. INDUSTRIAL ELECTRONICS (3) | Professor Stavely |
| 435, 435X. ENGINEERING ANALYSIS (3) | Professor Tarpley |
| 436. DESIGN, CONSTRUCTION, AND TESTING OF VACUUM TUBES (3) | Professor Nearhoof |
| 438. FUNDAMENTALS OF ELECTRIC WAVES (3) | |
| 440. VACUUM-TUBE CIRCUITS I (3) | Professor Van Meter |
| 441. VACUUM-TUBE CIRCUITS II (3) | |
| 450, 450X. ELECTRICAL NETWORK THEORY (3) | Professor Tarpley |
| 460. HIGH-VOLTAGE ENGINEERING (3) | Professor Armington |

ELECTRICAL ENGINEERING LABORATORY

PROFESSOR ARTHUR H. WAYNICK, M.S., Sc.D.
Head of the Department of Electrical Engineering

The following courses may be taken for graduate credit under the restrictions in force:

440. ELECTRICAL COMMUNICATIONS LABORATORY I (1½)
441. ELECTRICAL COMMUNICATIONS LABORATORY II (1½)

ENGINEERING

Consult DEAN ERIC A. WALKER, S.M., Sc.D.

The following courses may be taken for graduate credit under the restrictions in force:

400. PRODUCTION ENGINEERING (3)
410. NUCLEAR ENGINEERING (3)

ENGINEERING MECHANICS

PROFESSOR JOHN W. BRENNEMAN, C.E.
Acting Head of the Department

500. ADVANCED MECHANICS OF MATERIALS (3-6) Strain energy methods; special problems in bending and torsion; curved bars, beams on elastic foundations; thick-walled cylinders, shrink-fit assemblies, and rotating discs; thin-walled pressure vessels; bending of thin plates; buckling of bars and plates. Prerequisite: Mchs. 13. *Professors Marin and Hardenbergh*
504. APPLIED ELASTICITY (3) Analyses of stress and strain in two dimensions;

ENGINEERING MECHANICS

problems in elasticity and elastic stability; emphasis on applications to machine and structural design. Prerequisite: Mchs. 13. *Professor Marin*

506. EXPERIMENTAL STRESS ANALYSIS (3) Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; stress analogies; strain rosettes for combined stress determinations. Prerequisite: Mchs. 13. *Professor Marin*

507. THEORY OF ELASTICITY AND APPLICATIONS (3-6) General equations of stress and strain; applications to beams, curved members, rotating discs, thick cylinders, torsion members, plates, and other structural and machine parts. Prerequisite: Mchs. 13. *Professor Hardenbergh*

508. THEORY OF ELASTIC STABILITY AND APPLICATIONS (3) Buckling of slender and short members; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to internal pressures; applications to structural parts including aircraft members. Prerequisites: Mchs. 12, 13.

509. THEORY OF PLATES AND SHELLS (3) Bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without bending; applications to engineering problems. Prerequisite: Mchs. 13. *Professor Davids*

513. THESIS (1-9)

514. ENGINEERING MECHANICS SEMINAR (1 per semester) Current literature and special problems in engineering mechanics.

515. RESEARCH IN ENGINEERING MECHANICS (1-15 per semester) Investigation of a theoretical or experimental project in engineering mechanics.

520. ADVANCED DYNAMICS (3) Dynamics of a particle and of rigid bodies; Newtonian equations in moving co-ordinate systems; LaGrange's and Hamilton's equations of motion; special problems in vibrations and dynamics. Prerequisites: Mchs. 12, Math. 84 or 431. *Professors Davids and Sauer*

522. THEORY OF VIBRATIONS (3) Mathematical theory of vibrating systems; damping phenomena; forced vibrations; analogy between mechanical and electrical vibrations; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: Mchs. 13, Math. 84 or 431. *Professors Sauer and Vierck*

523. RELAXATION METHODS (3) Relaxation methods compared to iteration and other numerical methods of analysis; application to elasticity, plasticity, stability, fluid flow, heat transfer, and related fields. Prerequisite: Mchs. 522. *Professor Vierck*

524. MATHEMATICAL METHODS IN ENGINEERING (3) Matrix and tensor analysis, finite differences, relaxation, perturbation, and other approximate methods in solution of various engineering problems. Prerequisite: Math. 451 or E.E. 435 or M.E.Des. 404. *Professor Davids*

530. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for static and fatigue stresses; impact loads; creep of metals; applications to structural and machine design. Prerequisite: Mchs. 14. *Professor Marin*

531. THEORY OF PLASTICITY AND APPLICATIONS (3) Theory of plasticity including plastic torsion and bending of bars; thick-walled cylinders and rotating discs; buckling of bars and residual stresses; mechanics of creep. Prerequisite: Mchs. 504 or 507. *Professor Marin*
533. DETERMINATION OF MECHANICAL PROPERTIES (3) Experiments in fatigue, creep, impact, and combined stresses; true stress-strain diagrams.
540. MECHANICS OF CONTINUA (3) Unified mathematical treatment of elements of fluid mechanics and of elasticity and plasticity of solids. Prerequisite: Math. 84 or 431.
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
- 400, 400X. ADVANCED STRENGTH OF MATERIALS (3) *Professors Marin and Hardenbergh*
- 401, 401X. ELEMENTS OF VIBRATIONS (3) *Professor Vierck*
402. APPLIED AND EXPERIMENTAL STRESS ANALYSIS (3) *Professor Marin*
403. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) *Professor Marin*
404. RESEARCH IN ENGINEERING MECHANICS (1-6)

ENGLISH

PROFESSOR THEODORE J. GATES, M.A.

Head of the Department of English Composition

PROFESSOR BRICE HARRIS, M.A., Ph.D.

Head of the Department of English Literature

501. MATERIALS AND METHODS OF RESEARCH (3) Bibliography of literary history and criticism; methods of editing and annotating texts; form and materials of dissertations. Required of all graduate students with an English major. *Professor Ridenour*
502. ANCIENT AND MEDIEVAL RHETORIC AND POETIC (3) Rhetorical and poetic doctrine of ancient and medieval times. *Professor Reed*
507. RESEARCH PROBLEMS IN ENGLISH (1-6) Methods of research in English, problems of bibliography, and method of evaluating sources and materials.
508. BEOWULF (3) Reading of the text and study of the prominent literary problems and relationships. Prerequisite: E.Lit. 31. *Professor Mead*
509. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE PROSE WRITERS (3) *Professor Mead*
510. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE POETS (3) *Professor Locklin*
511. ELIZABETHAN DRAMA (3) *Professor Harris*
514. SHAKESPEARE (3) Special problems in the works of Shakespeare. *Professor Bowman*

ENGLISH

515. THE AGE OF SWIFT (3) Special studies varying from year to year.
Professor Harris
516. THE AGE OF JOHNSON (3) The work of Johnson and his circle.
Professor Mead
517. BYRON, SHELLEY, AND KEATS (3)
Professor Ridenour
518. PRE-ROMANTIC WRITERS (3) Development of Romantic ideas in the 18th century.
Professor Ridenour
519. WORDSWORTH, COLERIDGE, SOUTHEY, AND SCOTT (3)
Professor Ridenour
530. HISTORY OF THE ENGLISH LANGUAGE (3) Germanic background of English, phonological and morphological developments, dialect differentiations, and principles of linguistic change.
Professor Mead
531. OLD ENGLISH (3) Old English language and literature with lectures on Old English and Germanic philology.
Professor Mead
532. MIDDLE ENGLISH (3) Middle English language and literature with lectures on the development of Old English through Middle English to modern times.
Professor Mead
533. LITERARY CRITICISM (3) Historical survey of principles of literary criticism.
534. HISTORICAL ENGLISH GRAMMAR (3) Evolution of the grammatical system of English.
Professor Peck
535. RENAISSANCE AND MODERN RHETORIC (3) The rhetorical and poetic doctrine of Renaissance and modern times.
Professor Rubin
540. CHAUCER (3) Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences.
Professor Mead
542. PROSE STYLE (3) Development of English prose style from the Elizabethan age to Dryden.
Professor Major
543. CAVALIER AND ANGLICAN (3) Poetry and prose of the middle years of the 17th century from the death of Shakespeare to 1660.
Professor Mead
544. RESTORATION LITERATURE (3) Selected studies of writers in England between 1650 and 1700.
Professor Harris
545. POETS OF THE VICTORIAN PERIOD, EXCLUSIVE OF TENNYSON AND BROWNING (3)
Professor Long
546. TENNYSON AND BROWNING (3)
Professor Long
547. PROSE WRITERS OF THE VICTORIAN PERIOD (3)
Professor Long
550. SELECTED STUDIES IN THE BRITISH NOVEL TO 1840 (3)
Professor Bowman
551. SELECTED STUDIES IN THE BRITISH NOVEL FROM 1840 TO THE PRESENT (3)
Professor Sutherland
553. MODERN PROSE STYLE (3) English prose style from 1700 to the present. Continuation of Engl. 542.
Professor Major

554. RHETORICAL TECHNIQUES (3) Techniques of special types of writing, such as humor, satire, and propaganda. Prerequisites: 12 credits in English or American literature and 12 in English composition. *Professor Graves*
562. THE AMERICAN NOVEL (3) *Professor Werner*
563. AMERICAN ESSAYS (3) Lectures and reports on a special group of essayists. *Professor Werner*
565. THE AMERICAN SHORT STORY (3) *Professor Werner*
566. AMERICAN POETRY (3) *Professor Werner*
567. ANGLO-AMERICAN FOLK SONG (3) Oral tradition of melodies and texts; types, regions, theories. *Professor Bayard*
580. PRE-SHAKESPEAREAN DRAMA (3) *Professor Harris*
599. THESIS (1-15 per semester)

ENGLISH COMPOSITION

PROFESSOR THEODORE J. GATES, M.A.
Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

404. PUBLIC OPINION AND WRITTEN PERSUASION (3) *Professor Graves*
418. THE WRITING OF LITERARY CRITICISM (3) *Professor Rubin*

ENGLISH LITERATURE

PROFESSOR BRICE HARRIS, M.A., Ph.D.
Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

400. TEACHERS' COURSE IN LITERATURE (3)
401. MAIN CURRENTS IN AMERICAN LITERATURE (3) *Professor Merrill*
423. FORMS AND MOVEMENTS OF BRITISH LITERATURE (3) *Professor Ridenour*
- 439a,b,cS. OUR CONTEMPORARIES (3)
- 440a,b,cS. MASTERS OF LITERATURE (1-3)
- 441a,b,cS. MASTERS OF ENGLISH LITERATURE (1-3)
460. LITERARY BIOGRAPHY (3) *Professor Merrill*
464. SPENSER (3) *Professor Locklin*
466. MILTON (3) *Professor Harris*
- 475a,b,cS. WORLD LITERATURE IN ENGLISH (3-9)
484. AMERICAN DRAMA (3) *Professor Cloetingh*
485. SCANDINAVIAN DRAMA (3) *Professor Cloetingh*

ENGLISH LITERATURE

486. LATER BRITISH AND IRISH DRAMATISTS (3)
487. MODERN CONTINENTAL DRAMA (3)
489a,b,cS. COMPOSITE COURSE IN DRAMA (3-9)
489dS. CONTEMPORARY DRAMA (3)

Professor Cloetingh
Professor Cloetingh

ENTOMOLOGY

PROFESSOR PENNOYER F. ENGLISH, M.S., Ph.D.
Acting Head of the Department of Zoology and Entomology

505. ADVANCED MORPHOLOGY OF INSECTS (3) Advanced work in either external or internal morphology of insects. Prerequisites: Ent. 403, 405. *Professor Rutschky*
508. THE BIOLOGICAL CONTROL OF INSECTS (2) Artificial use of bacteria, fungous diseases, and animals in control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 6, 8, 407. *Professor Frost*
509. ENTOMOLOGICAL TECHNIQUE (2) For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 6. *Professor Frost*
513. ENTOMOLOGICAL RESEARCH (1-15 per semester) Prerequisites: Ent. 405, 407.
514. ADVANCED SYSTEMATIC ENTOMOLOGY (1-15 per semester) Taxonomy of various orders of insects selected to meet the needs of the individual student. Prerequisites: Ent. 403, 405. *Professor Rutschky*
528. INSECT PHYSIOLOGY (3) Normal functions of the insect body. Prerequisites: Ent. 405, Zool. 41. *Professor Dills*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. MEDICAL AND VETERINARY ENTOMOLOGY (3) *Professor Frings*
403. SYSTEMATIC ENTOMOLOGY (3) *Professor Rutschky*
405. INSECT MORPHOLOGY (3) *Professor Rutschky*
407. INSECT ECOLOGY (3) *Professor Frost*
413. ENTOMOLOGY SEMINAR (1 per semester) *Professor Frost*
429. PRINCIPLES OF INSECT CONTROL (3) *Professor Frost*
430. INSECT HISTOLOGY (2) *Professor Rutschky*
431. ENTOMOLOGICAL PROBLEMS (1-6)

FAMILY ECONOMICS AND HOME MANAGEMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.
Head of the Department of Home Management, Housing, and Art

500. RESEARCH IN FAMILY ECONOMICS OR HOME MANAGEMENT (1-6 per semester)

FAMILY ECONOMICS AND HOME MANAGEMENT

501. THESIS (1-15)

515, 515X. CONSUMER PROBLEMS (2-3) Methods of securing, evaluating, and presenting data concerning household commodities. For home economics teachers in high schools, colleges, and adult classes. Prerequisites: Fd.Ntr. 220, H.Mgmt. 442. *Professor Honey*

524. ECONOMIC PROBLEMS OF THE HOUSEHOLD (3) Economic problems of the present-day family; special emphasis on factors in household production, use of money income, and standards of living. Prerequisites: H.Mgmt. 439, Econ. 14. *Professor Honey*

528. HOME MANAGEMENT SUPERVISION (2-3) Evaluation of objectives and techniques in organization, supervision, and teaching of the home management house experience. Prerequisite: H.Mgmt. 439.

543. HOME MANAGEMENT IN RELATION TO FAMILY LIVING (3) Includes work with families in solution of their management problems. Prerequisites: Fd.Ntr. 220, H.Mgmt. 439. *Professor Wiesendanger*

544. SPECIAL PROBLEMS IN HOUSE MANAGEMENT (3) Specific management problems, such as social, financial, and material, including development of college level teaching aids. Prerequisite: 6 credits of home management or family economics courses in home economics. *Professor Wiesendanger*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

415. HOUSEHOLD BUYING PRACTICES (3)

419. MANAGING FAMILY FINANCIAL RESOURCES (3)

424. ECONOMIC CONDITIONS IN RELATION TO THE FAMILY (3)

439, 439X. HOME MANAGEMENT (2)

Professor Starr

442. RESIDENT EXPERIENCE IN HOME MANAGEMENT (3) Room and board will be charged at regular rates. *Professor Starr*

445. HOME MANAGEMENT EXPERIENCE (3)

Professor Starr

477. FAMILY MANAGEMENT (3)

FOODS, NUTRITION, AND HEALTH

PROFESSOR MIRIAM E. LOWENBERG, M.S., Ph.D.

Head of the Department

500. RESEARCH IN FOODS AND NUTRITION (1-6 per semester)

501. THESIS (1-15)

550. READINGS IN NUTRITION (3) Readings and reports of selected topics in nutri-

521. SEMINAR IN FOODS (1-6) Discussion and reports on current research in the foods field. Prerequisite or concurrent: Fd.Ntr. 520.

522. INDIVIDUAL FOOD PROBLEMS (2-6) Intensive study of specific problems in food preparation. Prerequisite: Fd.Ntr. 420.

FOODS, NUTRITION, AND HEALTH

523. ECONOMIC AND NUTRITIONAL PHASES OF MENU PLANNING (2-4) Food expenditures in relation to nutritional value and income. Prerequisites: Fd.Ntr. 450, Econ. 14.
550. READINGS IN NUTRITION (3) Readings and reports of selected topics in nutrition. Prerequisite: Fd.Ntr. 450.
551. NUTRITION SEMINAR (3-6) Selected topics and recent advances in nutrition. Prerequisite: Fd.Ntr. 450.
552. DIET IN DISEASES (3) Reports and discussions of problems of adaptation of diet to disorders of nutrition. Prerequisite: Fd.Ntr. 450.
553. NUTRITION OF CHILDREN (3) Nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: A.B.Ch. 35, Fd.Ntr. 450.
554. TECHNIQUES IN HUMAN NUTRITION RESEARCH (3) The more usual techniques employed by the research worker in human nutrition, accompanied by directed experience in their use and interpretation. Prerequisite or concurrent: Fd.Ntr. 551.
555. FIELD WORK IN NUTRITION (2-4) Field problems planned to meet needs of individual students. Prerequisite: Fd.Ntr. 450. Hours and problems to be arranged.
556. THE SURVEY METHOD IN FOODS AND NUTRITION (2) Study of survey technique as a tool in the assay of food adequacy and nutritional status. *Professor Dodds*
557. INTERRELATIONSHIPS OF NUTRIENTS (2) Interrelationships of nutrients in metabolic processes, their significance as applied to nutrition and in terms of the contribution of food stuffs. Prerequisites: Fd.Ntr. 450, A.B.Ch. 437.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 420. EXPERIMENTAL COOKERY (1-6) | <i>Professor Olson</i> |
| 421. ADVANCED FOODS (3) | <i>Professor Leucowich</i> |
| 425. FOOD PRESERVATION (1-2) | |
| 426. RECENT DEVELOPMENTS IN FOODS (3) | |
| 450. NUTRITION (4) | <i>Professors Padgett and Pike</i> |
| 451. FAMILY NUTRITION (3) | <i>Professor Padgett</i> |
| 452. ELEMENTS OF DIET IN DISEASE (3) | <i>Professor Pike</i> |
| 453. DIET THERAPY (3) | <i>Professor Padgett</i> |
| 455. TEACHING NUTRITION TO BOYS AND GIRLS (3) | <i>Professor Lowenberg</i> |
| 491, 491v. TEACHING HOME NURSING (1) | |

FORESTRY

PROFESSOR MAURICE K. GODDARD, M.S.
Head of the Department

500. NATIONAL AND STATE ADMINISTRATION (3-5) Comparison of the policy and administration of the national forests with the forests of other countries and of the different states.

502. WOOD FIBERS (3-5) Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulp-
ing quality, fiber measurements. *Professor White*
504. RESEARCH METHODS IN FORESTRY (2-6 per semester) Review of methods em-
ployed in conducting forestry research. *Professor Chisman*
508. FOREST ECOLOGY (2-4) Organization, development, and classification of forest
communities. *Professor Bramble*
509. COVERT MANAGEMENT (2) Management of forest associations for maintenance
and development of wildlife. Prerequisite: For. 508. *Professor Bramble*
510. SEMINAR (1-2 per semester) Current problems of forest research presented
as weekly seminar reports. May be repeated with additional credit for each
semester's work. *Professor Bramble*
530. RESEARCH IN WOOD UTILIZATION (3-6 per semester) Research in some phase
of wood utilization of forest products. Prerequisite: For. 431. *Professor Norton*
531. STRUCTURAL USES OF WOOD AND WOOD PRODUCTS (3-6 per semester) Wood as
a construction material; testing techniques for structural timbers and wood
assemblies; use of laminated wood, ring connectors, and other types of special
construction. Prerequisite: For. 404. *Professor Norton*
532. LAMINATES (3-6 per semester) Advanced and special studies in fabrication
and use of plywood, laminated wood, paper-base laminates, and wood-to-metal
bonding. Prerequisite: For. 405. *Professor Norton*
535. CONDITIONING TREATMENTS FOR WOOD (3-6 per semester) Advanced study and
problems in preservative, seasoning, and other special treatments for wood and
wood products. Prerequisite: For. 435. *Professor Norton*
550. FOREST MENSURATION (2-8 per semester) Research in some chosen field. Pre-
requisite: For. 450. *Professor Meyer*
560. FOREST MANAGEMENT (3-8) Special topics in forest management and research
in some chosen field. Prerequisite: For. 466. *Professor Meyer*
575. APPLICATIONS OF FOREST ECONOMICS AND FINANCE (3 per semester) Survey of
situations in forestry where business problems and particular circumstances of
production, value, and costs are currently significant. Prerequisite: For. 70.
Professor Humphrey
590. THE LUMBER INDUSTRY (2-4) Relation of the lumber industry to national
economy and world trade; lumbermen's associations; lumber accounts. Prerequi-
site: For. 430.
591. PROBLEMS IN LUMBERING (2-6) Research in some chosen phase of lumbering.
Prerequisite or concurrent: For. 590.
- In addition to these courses, the following may be taken for graduate credit under
the restrictions in force:*
400. ADVANCED SILVICULTURE (2) *Professor Chisman*
402. FOREST RESEARCH (2) *Professor Chisman*
404. MECHANICAL PROPERTIES OF WOOD (3) *Professor Nearn*

FORESTRY

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| 405. VENEER AND PLYWOOD (3) | <i>Professors Norton and Nearn</i> |
| 406. FORESTRY LITERATURE (1) | <i>Professor White</i> |
| 417. NATIONAL AND STATE FOREST PRACTICE (2) | |
| 421. REGIONAL SILVICULTURE (4) | <i>Professor Cope</i> |
| 427. FOREST USES (3) | <i>Professor Chisman</i> |
| 430. FOREST PRODUCTS AND INDUSTRIES (3) | <i>Professor Nearn</i> |
| 431. ADVANCED UTILIZATION (3-6) | <i>Professors Norton and Nearn</i> |
| 435. SEASONING AND PRESERVATION (3) | <i>Professor Nearn</i> |
| 445. IMPROVEMENTS (3) | <i>Professor Worley</i> |
| 450. ADVANCED MENSURATION (2) | <i>Professor Meyer</i> |
| 455. AERIAL PHOTOGRAMMETRY IN FOREST MANAGEMENT (2) | <i>Professor Worley</i> |
| 462. DEFECTS IN WOOD (3) | <i>Professor Norton</i> |
| 466. FOREST MANAGEMENT AND MANAGEMENT PLANS (4) | <i>Professor Meyer</i> |
| 468. SILVICULTURAL RESEARCH (2-4) | <i>Professor Chisman</i> |
| 469. PROBLEMS IN FOREST MANAGEMENT (3) | <i>Professor Meyer</i> |
| 475. PROBLEMS IN FOREST ECONOMICS AND FINANCE (3) | <i>Professor Humphrey</i> |
| 480. POLICY AND ADMINISTRATION (3) | |
| 491. LUMBERING (3) | <i>Professor Schmidt</i> |
| 492. LUMBER DISTRIBUTION (3) | <i>Professor Schmidt</i> |
| 494. LOGGING (3) | <i>Professor Schmidt</i> |
| 495. MILLING (3) | <i>Professor Schmidt</i> |
| 497. SMALL SAWMILLS (3) | <i>Professor Schmidt</i> |

FRENCH

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Acting Head of the Department of Romance Languages

- *1G. ELEMENTARY FRENCH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.
- 544. NEOCLASSICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Neoclassic movement in Italy, France, Spain, and Portugal. Prerequisite: Fr. 40.
- 545. ROMANTICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Romantic movement in Italy, France, Spain, and Portugal.
- 546. MEDIEVAL ROMANCE LITERATURES (3) Nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal.
- 547. REALISM, WITH PARTICULAR REFERENCE TO ROMANCE LITERATURES (3)
- 548. 20TH CENTURY ROMANCE LITERATURE AS A POLITICAL FORCE (3)
- 551. ROMANCE PHILOLOGY (3) Historical development of the Romance languages.
- 552. OLD AND MIDDLE FRENCH READINGS AND LITERATURE (3) Familiarizes the student with Old and Middle French texts from the earliest monuments to Villon. Prerequisite: Fr. 551.

* No graduate credit is given for this course.

553. FRENCH LITERATURE OF THE RENAISSANCE (3) The French Renaissance from 1498 to 1548.
554. THE RENAISSANCE IN THE ROMANCE LITERATURES (3) Themes and forms of literature in the humanistic period.
562. FRENCH THINKERS OF THE 18TH CENTURY (3)
564. FRENCH ROMANTICISM (3) The French Romantic Movement after 1830.
570. VOLTAIRE AND ROUSSEAU (3)
571. SEMINAR IN FRENCH LITERATURE (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.
572. SEMINAR IN FRENCH LITERATURE (3) Continuation of Fr. 571.
574. METHODS AND BIBLIOGRAPHY IN ROMANCE LANGUAGES AND LITERATURES (1-3)
580. PROUST AND GIDE (3)
599. DISSERTATION (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. FRENCH LITERATURE OF THE 16TH CENTURY (3)
401. FRENCH THEATER OF THE CLASSICAL PERIOD (3)
403. FRENCH DRAMATIC LITERATURE OF THE 18TH CENTURY (3)
405. FRENCH LITERATURE OF THE 19TH CENTURY (3)
406. FRENCH LITERATURE OF THE 19TH CENTURY (3)
407. FRENCH NOVEL OF THE 19TH CENTURY (3)
410. FRENCH POETRY OF THE 19TH CENTURY (3)
411. FRENCH PROSE OF THE 20TH CENTURY (3)
- 413, 413X. CONTEMPORARY FRENCH DRAMA (3)
415. FRENCH NOVEL OF THE 18TH CENTURY (3)
416. FRENCH POETRY AND DRAMA OF THE 20TH CENTURY (3)
421. THE TEACHING OF ROMANCE LANGUAGES (3)
471. PROBLEMS IN FRENCH LITERATURE (3-6)
490. ADVANCED COMPOSITION AND CONVERSATION (3)
496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

FUEL TECHNOLOGY

PROFESSOR C. C. WRIGHT, Ph.D.
Chief of the Division

502. RESEARCH DATA (3) Designed for the graduate student beginning laboratory research; methods of obtaining and interpreting research data. Prerequisite: Math. 30. *Professor Nielsen*
503. CHEMICAL CONSTITUTION AND SCIENTIFIC CLASSIFICATION OF COAL (3-6)
 Chemistry of plant constituents in relation to coal and the coalification process;

FUEL TECHNOLOGY

constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. *Professor Kinney*

504. FUEL TECHNOLOGY RESEARCH (1-15 per semester) Original research on preparation, carbonization, processing, utilization, or constitution of fuels. Results of the investigation may be used as the thesis. Prerequisites: Fuel T. 502, 503. *Professor Wright and Staff*

505. PHYSICOCHEMICAL PROPERTIES OF COAL, MINERAL MATTER, AND ASH (3) Physical, physicochemical, and use properties; their significance and applications. Prerequisite: Chem. 41.

506. ADVANCED COMBUSTION (3) Advanced combustion and heat balance calculations, ignition and flame characteristics of fuels; furnace atmospheres; selection of fuels with reference to use and equipment. Prerequisite: Chem. 41. *Professor Wright*

507. ADVANCED THERMAL PROCESSING (3) Pyrolysis, coal carbonization, coke manufacture and uses; action of heat on coals and fuels; technical and economic factors. Prerequisites: Chem. 35, 41, or Min. Pr. 410.

508. SYNTHESIS OF LIQUID FUELS (3) Chemical nature of liquid hydrocarbons; preparation of hydrogen and synthesis gas; theoretical and practical aspects of synthetic liquid fuel processes. Prerequisites: Chem. 31, Fuel T. 402. *Professor Kinney*

509. TECHNOLOGY OF TARS (3) Formation, constitution, physical and chemical properties of coal, oil-gas and water-gas tar; processing and utilization. Prerequisite: Chem. 31. *Professor Polansky*

510. FUEL TECHNOLOGY PROBLEM (1-6 per semester) Special problems in fuel technology. Prerequisite: Fuel T. 503. *Professor Wright and Staff*

511. FUEL TECHNOLOGY SEMINAR (1-6) Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 41. *Professor Wright and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. FUEL TECHNOLOGY RESEARCH AND DESIGN (1-3) *Professor Wright and Staff*

401. FUEL GASES AND GASIFICATION (3) *Professor Wright*

402. CHEMICAL PROCESSING OF FUELS (2) *Professor Kinney*

403. ENERGETICS OF FUEL TECHNOLOGY (3) *Professor Gauger*

404. FUEL TECHNOLOGY DESIGN (3) *Professor Spicer*

GENERAL HOME ECONOMICS

PROFESSOR DOROTHY HOUGHTON, M.S., Ph.D.
Assistant Dean of the School of Home Economics

500. RESEARCH IN GENERAL HOME ECONOMICS (1-6 per semester)

501. THESIS (1-15)

- 516, 516v. METHODS OF RESEARCH IN HOME ECONOMICS (3) Review of problems and techniques of research in home economics. Required of all graduate students in home economics. *Professor Hatcher*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 400, 400v, 400X, 400vX. RECENT FINDINGS IN HOME ECONOMICS (2-3)

GEOGRAPHY

PROFESSOR E. WILLARD MILLER, M.A., Ph.D.

Chief of the Division

503. ADVANCED REGIONAL GEOGRAPHY (3-12) Intensive study at an advanced level of selected regions or sections of the continents. Prerequisite: 12 credits in geography. *Professors Miller and Deasy*

504. PHYSICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professors Miller and Deasy*

505. ECONOMIC GEOGRAPHY SEMINAR (3-12) The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Miller*

506. CULTURAL AND POLITICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Griess*

510. PHYSICAL GEOGRAPHY RESEARCH (3-10) Original study in physical geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Deasy*

511. ECONOMIC GEOGRAPHY RESEARCH (3-10) Original study in economic geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Miller*

512. CULTURAL AND POLITICAL GEOGRAPHY RESEARCH (3-10) Original study in cultural and political geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Griess*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 400. REGIONAL GEOGRAPHY OF NORTH AMERICA (3) | <i>Professor Deasy</i> |
| 401. REGIONAL GEOGRAPHY OF PENNSYLVANIA (3) | <i>Professor Miller</i> |
| 403. REGIONAL GEOGRAPHY OF SOUTH AMERICA (3) | <i>Professor Griess</i> |
| 405. CULTURAL GEOGRAPHY (3) | <i>Professor Griess</i> |
| 427S. REGIONAL GEOGRAPHY OF THE SOVIET UNION (3) | |
| 433. REGIONAL CLIMATOLOGY (3) | <i>Professor Deasy</i> |
| 435. FIELD METHODS IN GEOGRAPHY (3) | <i>Professor Miller</i> |

GEOGRAPHY

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| 442. GEOGRAPHY OF EUROPE (3) | <i>Professor Miller</i> |
| 443. GEOGRAPHY OF THE ORIENT (3) | <i>Professor Rodgers</i> |
| 444. GEOGRAPHY OF AFRICA (3) | <i>Professor Griess</i> |
| 445. GEOGRAPHY OF THE AIR AGE (3) | <i>Professor Miller</i> |
| 452. INTERPRETATION OF AERIAL PHOTOGRAPHS (3) | <i>Professor Deasy</i> |
| 460. POLITICAL GEOGRAPHY (3) | <i>Professor Griess</i> |
| 480. GEOGRAPHY OF WORLD MANUFACTURING (3) | <i>Professor Miller</i> |

GEOLOGY

PROFESSOR FRANK M. SWARTZ, *Ph.D.*
Chief of the Division

- *500. GEOLOGY SEMINAR (1-9) Presentation, at weekly departmental meetings of topics selected from geological literature.
- †501. STRATIGRAPHY (3-12) Principles of stratigraphic classification, lithofacies and biofacies, faunal zonation, correlation, sedimentation, and paleogeography, illustrated by stratigraphy of classical geologic regions: (a) Pre-Cambrian; (b) Paleozoic; (c) Mesozoic; (d) Cenozoic. Prerequisite: Geol. 464. *Professor Swartz*
502. GEOLOGICAL RESEARCH (3-18) Original investigation of a geological problem approved by the chief of the division. Results of the investigation may be used for the thesis.
- †503. PALEONTOLOGY (3-9) Morphology of animal groups significant for their fossils; nature of species and faunal zones. Seminars may be arranged for studies of special fossil groups, microfossils, paleoecology. *Professor Swartz*
504. HISTORY OF GEOLOGY (2-3) Development through the ages of the scientific method in earth sciences. *Professor Krynine*
507. SEMINAR IN GEOMORPHOLOGY (3-6) Classic and current literature in geomorphology. *Professor Miller*
511. ORE DEPOSITS: PRINCIPLES (3-6) Geological and geochemical processes controlling ore deposition; genetic classification of ore deposits. Prerequisite: Geol. 451. *Professor Ridge*
512. ORE DEPOSITS: TYPES (3-6) Geologic history of selected ore bodies with respect to forming media; causes, sequences, and loci of emplacement; wall rock alteration and secondary enrichment. Prerequisite: Geol. 511. *Professor Ridge*
513. ORE DEPOSITS: CHEMICAL PROSPECTING (3-6) Methods of prospecting using techniques of geochemical, biochemical, and hydrochemical analysis. Prerequisites: Chem. 20, Geol. 451. *Professor Ridge*
514. ORE DEPOSITS: FIELD STUDY (1-2) Field study of ore deposits in eastern Pennsylvania, northern New Jersey, the Adirondacks, and eastern Ontario. Prerequisite: Geol. 512. *Professor Ridge*

* Credits to be arranged, 1 to 6 per semester.

† Credits to be arranged, 3 to 6 per semester.

515. ORE MICROSCOPY (2-3) Theory and use of the ore microscope in identifying ore minerals in polished section, establishing paragenetic sequences, determining manner of deposition. Prerequisite: Geol. 513. *Professor Ridge*
520. SEMINAR IN PALEOBOTANY (2-6) Current and classic literature concerning evolution, paleoecology, and geologic history of vascular plants. *Professor Spackman*
524. COAL PETROLOGY (1-6) Microscopy, source materials, coalification, constitution, classification of peats, lignites, bituminous coal, anthracite. *Professor Spackman*
530. GEOLOGICAL PROBLEMS (3-6) Study, from the literature, of a selected geological problem. Prerequisite: 10 credits of geology and mineralogy.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 420. PALEOBOTANY (3) | <i>Professor Spackman</i> |
| 424. GEOLOGY OF COAL (2) | <i>Professor Spackman</i> |
| 451. ECONOMIC GEOLOGY (3) | <i>Professor Scholten</i> |
| 461. GEOLOGY OF THE UNITED STATES (3) | <i>Professor Miller</i> |
| 462. PRINCIPLES OF GEOMORPHOLOGY (3-6) | <i>Professor Miller</i> |
| 464. PALEONTOLOGY (3) | <i>Professor Swartz</i> |
| 481. GEOLOGY OF OIL AND GAS (3) | <i>Professor Scholten</i> |
| 482. METALLIC MINERAL DEPOSITS (3) | |
| 483. STRUCTURAL GEOLOGY (3) | |
| 484. PALEOZOIC STRATIGRAPHY (3) | <i>Professor Swartz</i> |
| 485. PALEONTOLOGY (2) | <i>Professor Swartz</i> |
| 486. STRATIGRAPHIC METHODS (1) | <i>Professor Swartz</i> |
| 488. EARTH SCIENCES SEMINAR (1) | |
| 489. EARTH SCIENCES REPORT (1) | |

GEOPHYSICS AND GEOCHEMISTRY

PROFESSOR B. F. HOWELL, JR., M.S., Ph.D.
Chief of the Division

500. GEOPHYSICAL SEMINAR (1 per semester) Discussion of geophysical reports and papers; scientific outlook. Prerequisites: G.&G. 401, 402. *Professor Howell*
501. RESEARCH (1-15 per semester) Original research in geophysics or geochemistry.
502. SEISMIC INSTRUMENTS (2) Characteristics and design of seismometers and seismic recorders. Given alternate years. Prerequisites: Phys. 285, differential equations. *Professor Howell*
503. SPECIAL STUDIES IN GEOPHYSICS (1-9) Special studies of the theories of geophysical methods. Prerequisite: 6 credits in geophysics. *Professor Howell*
507. SEISMOLOGY (3) Nature and transmission of seismic waves; cause and oc-

G E O P H Y S I C S A N D G E O C H E M I S T R Y

- currence of earthquakes; applications in seismic prospecting. Prerequisites: Math. 431, Phys. 285. *Professor Howell*
508. TECTONICS (3) Seminar in the cause and nature of the principal deformations of the earth. Prerequisite: Geol. 483. *Professor Howell*
509. GEOCHEMISTRY SEMINAR (1 per semester) Prerequisite: G.&G. 406. *Professor Keith*
510. PROBLEMS IN GEOCHEMISTRY (1-9) Laboratory and library study of special problems. Prerequisite: G.&G. 406. *Professor Keith*
511. STRUCTURE AND PROPERTIES OF MINERAL MATTER (2-6) *Professor Buessem*
512. PRINCIPLES OF ELEMENT DISTRIBUTION IN THE EARTH (3-6) Principles and data from phase equilibrium, petrologic, and crystal structure studies as related to distribution of elements in the earth. Prerequisite: G.&G. 513. *Professor Osborn*
513. PHASE EQUILIBRIA IN MINERAL SYSTEMS (3-6) Phase relations and constitution of inorganic crystals and liquids; special emphasis on systems closely related to natural magmas and rock systems. Prerequisite: Min. 483. *Professor Osborn*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. MINING GEOPHYSICS (3)
402. PETROLEUM GEOPHYSICAL PROSPECTING (3) *Professor Howell*
403. GEOPHYSICS FIELD WORK (1-3) Summer practicum.
404. MINING GEOPHYSICS LABORATORY (1)
405. INTRODUCTORY GEOPHYSICS (3) *Professor Howell*
406. INTRODUCTORY GEOCHEMISTRY (3) *Professor Keith*
407. WELL LOGGING (2)

G E R M A N

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.
Head of the Department

- *1G. ELEMENTARY GERMAN FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.
501. GERMAN LANGUAGE SEMINAR (3-9) Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.
515. GERMAN LITERATURE SEMINAR (3-9) Special aspects and characteristics of individual writers and various types and periods of literature.
524. INTENSIVE STUDY OF THE LIFE AND WORKS OF GOETHE (3) Various phases of the poet's life and individual works. *Professor Buffington*

* No graduate credit is given for this course.

GERMAN

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| 531. SPECIAL STUDIES IN THE GERMAN LYRIC (3) | <i>Professor Shelley</i> |
| 532. SPECIAL STUDIES IN THE GERMAN DRAMA (3) | <i>Professor Adolf</i> |
| 533. SPECIAL STUDIES IN THE GERMAN SHORT STORY (3) | <i>Professor Steiner</i> |
| 534. SPECIAL STUDIES IN THE GERMAN NOVEL (3) | <i>Professor Adolf</i> |
| 551. MIDDLE HIGH GERMAN (3) Extensive reading of texts; characteristics of the various dialects. | <i>Professor Buffington</i> |
| 552. OLD HIGH GERMAN (3) Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A. D. Papers. | <i>Professor Buffington</i> |
| 553. GOTHIC (3) Essentials of the grammar; reading of Ulphilas' Bible translation. Suitable also for advanced students in English. Papers. | <i>Professor Adolf</i> |

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 400. PROSEMINAR IN BIBLIOGRAPHY AND METHODS OF RESEARCH (2) | <i>Professor Shelley</i> |
| 401. HISTORY OF THE GERMAN LANGUAGE (3) | <i>Professor Buffington</i> |
| 421. GERMAN LITERATURE IN THE 18TH CENTURY (3) | <i>Professor Buffington</i> |
| 422. GERMAN LITERATURE IN THE 19TH CENTURY (3) | <i>Professor Adolf</i> |
| 423. GERMAN LITERATURE OF THE 20TH CENTURY (3) | <i>Professor Steiner</i> |
| 443. LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9) | <i>Professor Shelley</i> |

GREEK

PROFESSOR ROBERT E. DENGLE, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following 400 and 500 courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

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| 500. GREEK COMPOSITION (2) Translation of extended narrative passages into Attic Greek; thorough review of forms and syntax; attention to rhetorical elements of the language. | <i>Professor Dengler</i> |
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In addition to this course, the following may be taken for graduate credit under the restrictions in force:

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| 411S. ESSENTIALS OF GREEK (3) | |
| 421. GREEK TRAGEDY (3) | <i>Professor Dengler</i> |
| 422. GREEK COMEDY (3) | <i>Professor Dengler</i> |
| 423. ATTIC ORATORS (3) | <i>Professor Dengler</i> |
| 424. GREEK HISTORY OR PHILOSOPHY (3) | <i>Professor Dengler</i> |
| 427. NEW TESTAMENT GREEK (3) | <i>Professor Dengler</i> |

HEALTH EDUCATION

Consult PROFESSOR ARTHUR L. HARNETT, JR., M.A., Ed.D.

501. HEALTH IMPLICATIONS IN THE GROWTH AND DEVELOPMENT OF SCHOOL CHILDREN (3) Child growth and development emphasis for teachers; medical inspection and examination; preschool program; early habit formations; behavior problems; co-operation of parents, teachers, and children. Prerequisite: Hl.Ed. 215.

Professor Davis

505. ADVANCED TECHNIQUES IN HEALTH EDUCATION (3) Prerequisites: Hl.Ed. 215, 399, Psy. 437.

Professor Harnett

572. TESTS AND MEASUREMENTS IN HEALTH EDUCATION (3) Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Ph.Ed. 490, Hl.Ed. 215, 399.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

403. FIRST AID, ATHLETIC CONDITIONING AND TRAINING (3)

Professor Fogg

405. RECENT DEVELOPMENTS IN PUBLIC HEALTH EDUCATION (3-6)

Professor Davis

406. RECENT DEVELOPMENTS IN SCHOOL HEALTH EDUCATION (3)

Professor Harnett

- 407, 407X. ADVANCED PERSONAL AND PUBLIC HEALTH (3)

Professor Harnett

- 411, 411X. SAFETY EDUCATION IN THE SCHOOLS (3)

Professor Davis

427. HEALTH FACTORS IN THE DEVELOPMENT OF THE ADOLESCENT (3)

Professor Davis

- 453, 453X. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION (3)

Professor Harnett

- 455S. RELATIONSHIPS OF HEALTH EDUCATION TO THE EXACT SCIENCES (3)

Professor Harnett

456. ADVANCED TECHNIQUES IN RURAL SCHOOL HEALTH (3)

Professor Davis

- 495S. FAMILY HEALTH AND HUMAN RELATIONS (3-9)

Professor Davis

HISTORY

PROFESSOR ALFRED G. PUNDT, M.A., Ph.D.

Head of the Department

500. SEMINAR IN AMERICAN HISTORY (3-6) Subject to be announced.
Professors Gray, Hermann, and Klein

501. EUROPEAN HISTORIOGRAPHY (3)

Professor Pundt

502. AMERICAN HISTORIOGRAPHY (3)

Professor Klein

506. THE DIPLOMATIC BACKGROUND OF THE WORLD WAR, 1871-1914 (3) Prerequisites: Hist. 18, 19.

507. THE REFORM MOVEMENT IN MODERN ENGLAND, 1832 TO THE PRESENT (3)

Professor Pundt

508. STUDIES IN EUROPEAN HISTORY, 1600-1789 (3)

Professor Pundt

509. THE FRENCH REVOLUTION AND NAPOLEONIC ERA, 1789-1815 (3) Prerequisites: Hist. 18, 19. *Professor Pundt*
511. SEMINAR IN EUROPEAN HISTORY (3-6) *Professors Forster and Pundt*
512. STUDIES IN PENNSYLVANIA HISTORY (3-6) *Professor Klein*
520. THE AMERICAN REVOLUTION, 1763-1783 (3) Prerequisites: Hist. 20, 21. *Professor Hermann*
529. CULTURAL HISTORY OF THE EARLY MIDDLE AGES (3) *Professor Dahmus*
532. STUDIES IN MEDIEVAL CIVILIZATION (3) *Professor Dahmus*
533. STUDIES IN HISTORY OF THE UNITED STATES, 1829-1860 (3) *Professor Klein*
534. THE CIVIL WAR AND RECONSTRUCTION, 1860-1877 (3) Prerequisites: Hist. 20, 21. *Professors Klein and Hermann*
536. STUDIES IN THE HISTORY OF THE UNITED STATES, 1877-1900 (3)
538. STUDIES IN THE HISTORY OF FOREIGN RELATIONS OF THE UNITED STATES, 1492 TO THE PRESENT (3)
562. SEMINAR IN LATIN-AMERICAN HISTORY (3-6) Prerequisites: Hist. 22, 23. *Professor Gray*
563. STUDIES IN THE HISTORY OF THE CARIBBEAN AREA (3) Prerequisites: Hist. 22, 23. *Professor Gray*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 405, 405X. HISTORICAL BACKGROUND OF AMERICAN POLITICAL PARTIES, 1607-1900 (3) *Professor Rayback*
406. HISTORY OF AMERICAN LABOR (3) *Professor Rayback*
407. THE DIPLOMATIC HISTORY OF THE UNITED STATES (3) *Professor DeNovo*
418. RENAISSANCE AND REFORMATION (3)
- 419, 419X. RECENT EUROPEAN HISTORY (3) *Professor Forster*
- 421, 421X. RECENT AMERICAN HISTORY (3)
423. THE FORMATIVE PERIOD OF AMERICAN HISTORY (3) *Professor Klein*
437. THE MIDDLE AGES FROM CONSTANTINE TO THE CRUSADES (3) *Professor Dahmus*
438. THE MIDDLE AGES FROM THE CRUSADES TO THE RENAISSANCE (3) *Professor Dahmus*
439. HISTORY OF ENGLAND TO 1485 (3) *Professor Dahmus*
440. HISTORY OF ENGLAND AND GREAT BRITAIN SINCE 1485 (3) *Professor Forster*
441. RECENT HISTORY OF GREAT BRITAIN (3) *Professor Forster*
443. HISTORY OF MODERN RUSSIA (3)
444. EASTERN EUROPE IN MODERN TIMES (3)
446. DEVELOPMENT OF THE BRITISH EMPIRE (3)
447. ECONOMIC DEVELOPMENT OF MODERN EUROPE SINCE 1750 (3) *Professor Pundt*
448. SOCIAL AND CULTURAL HISTORY OF MODERN EUROPE (3)
450. ECONOMIC DEVELOPMENT OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 451. *Professor Hermann*

HISTORY

451. SOCIAL AND CULTURAL HISTORY OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 450. *Professor Hermann*
452. SOCIAL AND CULTURAL HISTORY OF THE UNITED STATES SINCE 1783 (3) *Professor Brown*
453. AMERICAN POLITICAL BIOGRAPHY (3) *Professor Hermann*
454. THE ECONOMIC DEVELOPMENT OF THE UNITED STATES IN THE 19TH CENTURY (3) *Professor McNall*
460. LATIN AMERICA AND THE UNITED STATES (3) *Professor Gray*
461. SOCIAL AND CULTURAL HISTORY OF LATIN AMERICA (3) To alternate with Hist. 460. *Professor Gray*
499X. FOREIGN STUDY IN HISTORY (2-6)

HOME ART

PROFESSOR CHRISTINE F. SALMON, B.Arch., M.Arch.
Chairman of the Division

500. RESEARCH IN HOME ART (1-6 per semester)
501. THESIS (1-15)
515. BACKGROUNDS OF THE HOME ARTS (3) Evaluation of useful objects in respect to their form, function, and time; selections for exhibition. Prerequisites: H.Art 216 or Art 54 or Art Ed. 6, and Art 74 or H.Art. 240.
541. ART IN THE ENVIRONMENT (3) Approach based upon human needs with consideration of materials in the light of their use in home living. Prerequisite: Art 76 or Art Ed. 5 or H.Art 440.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. SPECIAL PROBLEMS IN HOME FURNISHINGS (3)
433, 433X. ADVANCED HOME CRAFTS (2-12)
434. THE ART AND THE CRAFTS IN THE HOMEMAKING PROGRAM (3-6)
440, 440X. HOME FURNISHING PROBLEMS (3)
443. HOME ARTS IN THE ADULT PROGRAM (3)
444, 444X. HOME FURNISHING TEACHING PROBLEMS (3)
447, 447X. HOME FURNISHINGS FOR THE FAMILY (3)

HOME-COMMUNITY RELATIONSHIPS

Consult PROFESSOR WILLIAM M. SMITH, JR., M.S., Ph.D.

500. RESEARCH IN HOME-COMMUNITY RELATIONSHIPS (1-6 per semester)
501. THESIS (1-15)
502, 502v, 502X, 502vX. HOME ECONOMICS AND AMERICAN SOCIETY (3) Family life

education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.

503. GRADUATE SEMINAR IN HOME ECONOMICS (1)

Professor Henderson

HOME ECONOMICS EDUCATION

PROFESSOR JEAN D. AMBERSON, M.A., Ph.D.
Head of the Department

500,500v. RESEARCH IN HOME ECONOMICS EDUCATION (1-6 per semester)

Professor Amberson or Hatcher

501,501v. THESIS (1-15)

502,502v. HOME ECONOMICS INSTRUCTION AT THE COLLEGE LEVEL (3) Teaching techniques suitable for college instruction in home economics; for prospective home economics college teachers not majoring in home economics education.

503,503v. PROBLEMS IN HOME ECONOMICS TEACHER EDUCATION (3) Organization of college programs of teacher education; use of resources; records; field services; recruitment and selection of personnel. Prerequisite: at least two years of experience in teaching home economics.

504,504v. CURRENT DEVELOPMENTS IN EDUCATION IN RELATION TO HOME ECONOMICS (3) Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics.

Professor Amberson

505,505v,505X,505vX. PRACTICUM IN TEACHING HOME ECONOMICS IN THE SECONDARY SCHOOL (3-6) Projects in home economics education which may be carried out in the school in which the teacher is regularly employed.

Professor Amberson

509,509v,509X,509vX. CURRICULUM WORKSHOP IN FAMILY LIFE EDUCATION (3) Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics.

Professor Amberson or Hatcher

510,510v,510X,510vX. THE SUPERVISION OF HOME ECONOMICS TEACHING (2-6) For teachers of home economics desiring to qualify as city, county, or student teacher supervisors. Prerequisite: graduation from four-year teacher training curriculum and two years' teaching experience in home economics.

Professors Amberson, Hatcher, or Riegel

518,518v,518X,518vX. EVALUATION IN FAMILY LIFE EDUCATION (3) Methods of evaluating progress toward goals in home economics education and use of findings in program planning and revision.

Professor Hatcher

521,521v,521X,521vX. HOME ECONOMICS EDUCATION SEMINAR (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems. *Professor Amberson or Hatcher*

HOME ECONOMICS EDUCATION

526, 526v, 526X, 526vX. THE COMMUNITY PROGRAM IN FAMILY LIFE EDUCATION (2-3) Ways of discovering community needs and resources; methods in developing the community program in family living; leadership education for the lay member of the community.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 406, 406v, 406X, 406vX. TEACHING AIDS IN FAMILY LIFE EDUCATION (1-4)
427, 427v, 427X, 427vX. FAMILY LIFE EDUCATION (3)
443, 443v, 443X, 443vX. ADULT HOMEMAKING EDUCATION (3)
463, 463v. SENIOR SEMINAR (1)
466, 466v. STUDENT TEACHING (9)
478, 478v, 478X, 478vX. APPRAISING STUDENT PROGRESS IN EDUCATION FOR FAMILY LIVING (3)
479, 479v, 479X, 479vX. READINGS IN HOME ECONOMICS EDUCATION (1-4)

HORTICULTURE

PROFESSOR RUSSELL E. LARSON, M.S., Ph.D.
Acting Head of the Department

500. ECOLOGY OF FRUIT PLANTS (3) Factors limiting the distribution and intensity of culture of fruit species and varieties and effect of environmental factors on cultural practices.

501. POMOLOGY RESEARCH (2-12) Investigation of problems involving review of literature, field and laboratory research. Prerequisite or concurrent: Hort. 445.

Professor White

503. EXPERIMENTAL PLANT BREEDING (3-6) Problems based mainly on research work of the department, with review of experimental methods and literature. Prerequisite: Hort. 444.

Professor Larson

504. VEGETABLE CROP RESEARCH (2-9) Investigation of problems involving review of literature, field and laboratory research. Prerequisite: Hort. 420 or 424.

Professor Odland

505. PROBLEMS IN VEGETABLE PRODUCTION (2-6) Methods used in the more valuable contributions to vegetable production. Prerequisite: Hort. 420 or 424.

Professor Odland

506. NUTRITION OF HORTICULTURAL CROPS (2-4) Principles, applications, and interpretations of diagnostic methods for determining fertilizer requirements of horticultural crops.

Professor Smith

507. PLANT BREEDING RESEARCH (3-6) Critical review of breeding projects of the department, with original investigations. Prerequisite: Hort. 444.

Professor Larson

512. PRINCIPLES OF FRUIT AND VEGETABLE STORAGE (2-4) Principles involved in the maturation, storage, and senescence of fruits and vegetables, and their application.

513. RESEARCH IN ORNAMENTAL HORTICULTURE (2-12) Review of research in ornamental horticulture, with original investigations. *Professor Meahl*
514. PROPAGATION OF ORNAMENTAL AND FRUIT PLANTS (3) Factors affecting the asexual and sexual propagation of fruit and ornamental plants. *Professor Meahl*
517. HORTICULTURE SEMINAR (1 per semester) Review of current research publications in horticulture. Each student presents one or more reviews of assigned topics.
518. RESEARCH PROBLEMS IN LANDSCAPE HORTICULTURE (2-12) Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. *Professor Bracken*
519. SEMINAR ON THE GENETICS OF HORTICULTURAL CROPS (1 per semester) Review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics.
520. SEMINAR ON THE BREEDING OF HORTICULTURAL CROPS (1 per semester) Each student presents one or more reviews of literature on assigned topics.
521. TECHNICAL PRACTICES IN LANDSCAPE CONTRACTING (2-12) Commercial and technical operations in landscape contracting and maintenance services. Prerequisites: Hort. 460, 461. *Professor Bracken*
523. PROPAGATION AND IMPROVEMENT OF VEGETABLE AND FLOWER CROPS (3) Methods and special techniques in breeding of flowers and vegetables; maintenance of seed stocks and seed production. Prerequisite: Hort. 444. *Professor Odland*
524. EXPERIMENTAL PROCEDURES IN HORTICULTURAL RESEARCH (3) *Professor Larson*
525. HORTICULTURAL RESEARCH TECHNIQUES (3) Practice in and comparison of methods and apparatus used in horticultural research. *Professor White*
526. RESEARCH IN FLORICULTURE (2-12) Greenhouse research and review of literature. Prerequisite or concurrent: Hort. 427, 428. *Professor Seeley*
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
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| 418. SUBTROPICAL AND TROPICAL FRUITS (3) | <i>Professor White</i> |
| 420. ADVANCED COMMERCIAL VEGETABLE PRODUCTION (3) | <i>Professor Larson</i> |
| 423. ADVANCED FRUIT AND VEGETABLE PROCESSING (3) | <i>Mr. Thomas</i> |
| 424. ADVANCED OLERICULTURE (3-6) | <i>Professor Odland</i> |
| 427. ADVANCED FLORICULTURE (3) | |
| 428. ADVANCED FLORICULTURE (3) | |
| 434. RECREATION AREAS AND FACILITIES (4) | <i>Professor Wilson</i> |
| 444. ADVANCED PLANT BREEDING (3-6) | <i>Professor Larson</i> |
| 445. ADVANCED POMOLOGY (3) | <i>Professor White</i> |
| 446. ADVANCED POMOLOGY (1-3) | <i>Professor White</i> |
| 447. PROBLEMS IN POMOLOGY (1-3) | <i>Professor White</i> |
| 453. NURSERY PRINCIPLES AND PRACTICE (3) | <i>Professor Meahl</i> |
| 454. LANDSCAPE PROBLEMS (3-6) | <i>Professor Bracken</i> |
| 455. LANDSCAPE PROBLEMS (3-6) | <i>Professor Bracken</i> |
| 456. PROBLEMS IN NURSERY PRACTICE (3) | <i>Professor Meahl</i> |

HORTICULTURE

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| 460. LANDSCAPE HORTICULTURE PROJECTS (3) | <i>Professor Bracken</i> |
| 461. PARKS AND PARK ADMINISTRATION (3) | <i>Professor Wilson</i> |
| 462. INSTITUTIONAL GROUNDS AND THEIR ADMINISTRATION (3) | <i>Professor Wilson</i> |
| 463. LANDSCAPE HORTICULTURE PROJECTS (1-6) | <i>Professor Bracken</i> |

HOTEL ADMINISTRATION

PROFESSOR ESTHER A. ATKINSON, M.S.

Head of the Department of Hotel and Institution Administration

The following courses may be taken for graduate credit under the restrictions in force:

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| 440. HOTEL OPERATIONAL LIABILITIES (2) | <i>Professor Bower</i> |
| 445. HOTEL ORGANIZATION AND OPERATION (3) | <i>Professor Bower</i> |

HOUSING AND HOME EQUIPMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.

Head of the Department of Home Management, Housing, and Home Art

500. RESEARCH IN HOUSING AND EQUIPMENT (1-6 per semester)

501. THESIS (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 413. HOME EQUIPMENT (3) | |
| 470, 470X. HOUSING THE FAMILY (2-3) | <i>Professor Wiesendanger</i> |

INDUSTRIAL ARTS

PROFESSOR S. LEWIS LAND, M.S., Ph.D.

Head of the Department of Industrial Education

PROFESSOR JOHN F. FRIESE, M.S.

574. HISTORY AND PHILOSOPHY OF INDUSTRIAL ARTS (2-3) Historical developments and concurrent educational philosophies of industrial arts in American education. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

575. PROBLEMS IN INDUSTRIAL ARTS EDUCATION (2-3) Subject matter, projects, methods of manual and informational teaching, aids and devices, selection of text and reference materials, personnel organization, shop management, problem pupils. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

576. SUPERVISION AND ADMINISTRATION OF INDUSTRIAL ARTS EDUCATION (2-3) How to organize, supervise, and administer functioning programs of industrial arts; duties of a supervisor and director of industrial arts. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

577. TESTING IN INDUSTRIAL ARTS (2-3) Construction of informal manipulative and written tests; use of standardized mechanical aptitude and achievement tests; construction and use of rating scales; scoring and grading; interpretation of test results. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

578. RESEARCH IN INDUSTRIAL ARTS (1-18) Prerequisite: 6 hours in professional courses in industrial arts.

Unit A. Research Techniques in Industrial Arts (2-3)

Unit B. Research in Industrial Arts (1-15) On campus.

Unit C. Research in Industrial Arts (1-6 per semester) Off campus.

579. MASTER'S THESIS IN INDUSTRIAL ARTS (1-6) Conferences and assignments relating to the preparation of an acceptable thesis for the Master of Science or Master of Education degrees. Prerequisite: 6 hours in professional courses in industrial arts.

580. SEMINAR IN INDUSTRIAL ARTS (2-9) Directed intensive study, investigation, or research in selected phases of the program; reports and constructive criticism. Prerequisites: 6 hours in professional courses in industrial arts and teaching experience.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

407, 407X. INDUSTRIAL ARTS EDUCATION (2-3)

421, 421X. CURRICULUM MATERIALS IN INDUSTRIAL ARTS (2-3)

470, 470X. PROBLEMS IN SENIOR HIGH SCHOOL INDUSTRIAL ARTS (2-3)

INDUSTRIAL EDUCATION

PROFESSOR S. LEWIS LAND, M.S., Ph.D.

Head of the Department

501v. SEMINAR IN VOCATIONAL EDUCATION (1-12) Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators.

506v. ADMINISTRATION OF VOCATIONAL EDUCATION (1-6) The job of the local director of industrial education in organizing and developing city and other local programs of industrial education. Prerequisite: 6 semester hours in industrial education or valid director's certificate, equivalent training and experience.

510v. VOCATIONAL EDUCATION FOR ADMINISTRATORS (2-3) Designed for school administrators and supervisors who desire an understanding of practical arts and vocational education. Prerequisite: Ind.Ed. 1v or trade or teaching experience.

INDUSTRIAL EDUCATION

550v. RESEARCH IN VOCATIONAL EDUCATION (1-15)

Unit A. Research Techniques in Vocational Industrial Education (2-3)

Unit B. Research in Vocational Industrial Education (1-15) On campus.

Unit C. Research in Vocational Industrial Education (1-6 per semester) Off campus.

555v. CURRENT PROBLEMS IN VOCATIONAL EDUCATION (1-6) Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome.

Unit A. Changing Industrial, Economic, and Social Conditions (1)

Unit B. Policies and Program of the American Vocational Association (1)

Unit C. Federal and State Vocational Legislation, Present and Pending (1)

Unit D. Financing Vocational Education (1)

Unit E. Current Administrative Problems in Vocational Education (1)

Unit F. Current Administrative Problems in Vocational Education (continued) (1)

558v. FRONTIER PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (2-3 per unit)

Unit A. Federal Legislation (2-3)

Unit B. Present-Day Local Personnel and Curriculum Problems (2-3)

Unit C. State and Local Supervision and Administration (2-3)

560v. PHILOSOPHY OF INDUSTRIAL EDUCATION (2-3) Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices. Prerequisite: 12 credits in industrial education or teaching experience.

590v. MASTER'S THESIS IN INDUSTRIAL EDUCATION (2-6) Conferences and assignments relating to selection and preparation of an acceptable thesis for the degree of Master of Education or Master of Science.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401v, 401vX. HISTORY OF INDUSTRIAL EDUCATION (2-3)

402v, 402vX. SUPERVISION OF VOCATIONAL EDUCATION (2-3)

403v, 403vX. SUPERVISED FIELD WORK (1-6)

405v, 405vX. CONFERENCE LEADER TRAINING (2-3)

408v, 408vX. OCCUPATIONS (2-3)

409v, 409vX. TESTS AND MEASUREMENTS (2-3)

412v, 412vX. SPECIAL PROBLEMS IN VOCATIONAL EDUCATION (2-4)

414v, 414vX. VOCATIONAL EDUCATIONAL GUIDANCE (2-3)

415vS, 415vX. PROBLEMS IN CO-ORDINATING VOCATIONAL EDUCATION (2-3)

418v, 418vX. PROBLEMS IN AUDIO-VISUAL AIDS IN INDUSTRIAL EDUCATION (2-3)

420v, 420vX. OCCUPATIONAL HYGIENE (2-3)

425v, 425vX. WORKSHOP IN INDUSTRIAL EDUCATION (1-6)

427v, 427vX. ADVANCED COURSE OF STUDY BUILDING (2-3)

446vS, 446vX. IMPROVEMENT OF INSTRUCTION IN VOCATIONAL EDUCATION (2-4)

450v, 450vX. SHOP LAYOUT AND MANAGEMENT (2-3)

458v. EMERGING PROBLEMS IN VOCATIONAL EDUCATION (1-7)

Unit A. Federal and State Laws Relating to Vocational Education (1)

Unit B. Framework of Federal, State, and Local Administrative Agencies (1)

Unit C. Federal, State, and Local Policies and Plans for Vocational Education (1)

Unit D. Local Administration of Vocational Education (1)

Unit E. Labor Laws and Labor Relations Affecting Education (1)

Unit F. Vocational Training for War and Postwar Eras (1)

Unit G. Problems in Vocational Rehabilitation of the Physically Handicapped (1)

460S. PROBLEMS IN VOCATIONAL REHABILITATION OF THE HANDICAPPED (1-6)

Unit A. The Counseling Interview in Vocational Rehabilitation (1-3)

Unit B. Occupational Information and Placement Techniques in Vocational Rehabilitation (1-3)

INDUSTRIAL ENGINEERING

PROFESSOR CLARENCE E. BULLINGER, I.E., M.S.

Head of the Department

501. MANUFACTURING METHODS (2-8) Special projects including investigation; experimentation, design, and research of some one or more special types of manufacture. *Professor Bullinger*

502. MANAGEMENT METHODS (3-6) Intensive study of newer phases of scientific management, including production control and application of Gantt charts; research on special problems. *Professor Bullinger*

503. PERSONNEL RELATIONS (2-8) Research on special topics. *Professor Bullinger*

505. GRAPHICAL COMPUTATION (2-10) Construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. *Professor Bullinger*

506. TIME AND MOTION STUDY (3-9) Machine data, elementary and fundamental machine times; determination of fatigue curves; design of Barth slide rules, micromotion study and chart plotting of micromotion results; chronocyclegraph study. *Professor Anderson*

507. BUDGETARY CONTROL AND STANDARD COSTS (3-6) Divisional budgets as control media; establishing standard cost data; standard cost accounting procedures, and use of cost variances in controlling manufacturing operations. Prerequisite: I.E. 401. *Professor Hussey*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. INDUSTRIAL ACCOUNTS (4) *Professor Hussey*

404. SCIENTIFIC MANAGEMENT (2) *Professor Bullinger*

406. FACTORY PLANNING (2) *Professor Thuering*

409. PERSONNEL ADMINISTRATION (3) *Professor Thomas*

411. MANUFACTURING BUDGETS (2) *Professor Hussey*

422a,b,c,d,e,f. INDUSTRIAL ENGINEERING PROBLEMS (2 per unit)

Professors Babcock, Bullinger, Anderson, Hussey, and Thomas

423. QUALITY CONTROL (2-3) *Professor Bullinger*

424. JOB EVALUATION (3) *Professor Thomas*

429. PLASTIC WORKING OF METALS (3) *Professor Roscoe*

INSTITUTION ADMINISTRATION

PROFESSOR ESTHER A. ATKINSON, M.S.

Head of the Department of Hotel and Institution Administration

- 500. RESEARCH IN INSTITUTION ADMINISTRATION (1-6 per semester)
- 501. THESIS (1-15)
- 502. PROBLEMS IN INSTITUTIONAL ADMINISTRATION (3-6) Individual study of problems in institutional administration. Prerequisites: In.Adm. 326, 330.

Professor Atkinson

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 410. TEA ROOM MANAGEMENT (3)
- 437a,b,cS. SCHOOL CAFETERIA PROBLEMS (1-3) Units A, B, C. 1 credit per unit.
- 438. SCHOOL LUNCH ADMINISTRATION (3)
- 461. INSTITUTION ADMINISTRATION (3)
- 462. INSTITUTION EXPERIENCE (3)

INTERNATIONAL UNDERSTANDING

Consult PROFESSOR WILLIAM H. GRAY, M.A., Ph.D.

The following course may be taken for graduate credit under the restrictions in force:

- 400S. WORLD AFFAIRS AND INTERNATIONAL UNDERSTANDING (3)

ITALIAN

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Acting Head of the Department of Romance Languages

- 571. SEMINAR IN ITALIAN LITERATURE (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

JOURNALISM

PROFESSOR FRANKLIN C. BANNER, M.A.

Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

- 416. ADVANCED COPY READING (3)
- 424. ADVANCED REPORTING (3)
- 430. SUPERVISION AND MANAGEMENT OF SCHOOL PUBLICATIONS (3)
- 441. ADVANCED ADVERTISING COPYWRITING (3)
- 480. PROBLEMS OF PUBLISHING (3)

LATIN

PROFESSOR ROBERT E. DENGLER, A.M., Ph.D.
Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

500. **LATIN LITERATURE** (3) Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures.
Professor Dengler
501. **ROMAN RELIGION AND PHILOSOPHY** (3) Development of religious concepts at Rome from primitive Italic origins to the advanced forms that culminated in Roman Stoicism.
Professor Krauss
502. **LATIN EPIGRAPHY** (3) Lectures and readings on Roman inscriptions; illustrative exercises.
Professor Krauss
503. **LATIN PALEOGRAPHY** (3) The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises.
Professor Dengler
504. **ROMAN TOPOGRAPHY** (3) Physical development of the city of Rome, its walls, aqueducts, bridges, streets, fora, public buildings, temples, etc.; building materials and methods of construction.
Professor Krauss
510. **LATIN SEMINAR** (3)
518. **LATIN RESEARCH** (1-3) Prosecution of an assigned problem under the guidance of a member of the department.
Professor Dengler
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
428. **LUCRETIUS** (3) *Professor Krauss*
 429. **QUINTILIAN** (3) *Professor Krauss*
 431. **JUVENAL** (3) *Professor Krauss*
 436S. **FUNCTIONAL PROBLEMS IN LATIN** (3)
 440a,b,c,dS. **COLLEGE LATIN** (3-12) *Professor Dengler*

LIBRARY SCIENCE

Consult LIBRARIAN RALPH W. McCOMB, M.A.

The following courses may be taken for graduate credit under the restrictions in force:

- 403S. **INTERMEDIATE DICTIONARY CATALOGING AND SUBJECT HEADINGS** (2-3)
 405S. **INTERMEDIATE REFERENCE WORK AND BIBLIOGRAPHY** (2-3)
 407S. **SPECIAL PROBLEMS IN SCHOOL LIBRARY SERVICE** (6)

MATHEMATICS

PROFESSOR ORRIN FRINK, JR., M.A., Ph.D.

Head of the Department

500. ANALYTICAL MECHANICS (3) An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math. 419 or Phys. 461.
- 501-502. THEORY OF FUNCTIONS OF A REAL VARIABLE (3 each) Theory of real functions, sets, measure, derivatives, and integrals. Prerequisite: Math. 420.
503. FOURIER SERIES AND HARMONIC FUNCTIONS (3) Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisites: Math. 90, 420.
505. INTEGRAL EQUATIONS (3) Fredholm and Volterra equations, and applications. Prerequisite: Math. 421.
507. CALCULUS OF VARIATIONS (3) Prerequisites: Math. 90, 421.
- 508-509. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (3 each) Development of the complex number system; theory of analytic functions. Prerequisite: Math. 421.
510. THEORY OF GROUPS (3) General properties of groups with applications. Prerequisite: Math. 471 or 535.
- 511-512. INTRODUCTION TO HIGHER ALGEBRA (3 each) Algebra of matrices, determinants, bilinear and quadratic forms. Prerequisite: Math. 11.
- 513-514. ADVANCED ANALYTIC GEOMETRY (3 each) Introduction of homogeneous co-ordinates and their use in the study of projective properties. Prerequisite: Math. 30.
- 520-521. PROJECTIVE GEOMETRY (3 each) General study of the subject from the postulational standpoint. Prerequisite: Math. 30. Alternate years or as required.
- 522-523. METRIC DIFFERENTIAL GEOMETRY (3 each) The usual classical treatment of the subject. Prerequisite: Math. 11 or 30.
- 530-531. TOPOLOGY (3 each) Topological spaces, combinatorial topology, applications to algebra and analysis.
534. THEORY OF ALGEBRAIC NUMBERS (3) Introduction to the number theory of quadratic fields, with study of the theory of ideals in quadratic and higher fields, with application. Prerequisites: Math. 404, 471.
- 535-536. MODERN ALGEBRAIC THEORIES (3 each) Algebraic invariants, matrices, quadratic and Hermitian forms, Galois theory of equations, modular systems, etc. Prerequisite: Math. 471.
- 550-551. MATHEMATICAL LOGIC (3 each) The logical basis of mathematics and its ultimate nature. Prerequisite: Math. 471 or Phil. 428.
- 552-553. NUMERICAL METHODS (3 each) Procedures for practical calculation, including interpolation, solution of equations, iterative methods, harmonic analysis and use of modern calculating equipment. Prerequisite: Math. 420.

- 560-561. THEORY OF DIFFERENTIAL EQUATIONS (3 each) Prerequisites: Math. 90, 421.
570. SPECIAL TOPICS IN GEOMETRY (3-6)
571. SPECIAL TOPICS IN ANALYSIS (3-6)
572. SPECIAL TOPICS IN ALGEBRA (3-6)
573. SPECIAL TOPICS IN APPLIED MATHEMATICS (3-6)
574. SPECIAL TOPICS IN FOUNDATIONS OF MATHEMATICS (3-6)
- 575-576. MATHEMATICS SEMINAR (1-6 each) Selected topics from recent mathematical developments.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

403. MODERN METHODS IN GEOMETRY (3)
404. THEORY OF NUMBERS (3)
405. PARTIAL DIFFERENTIAL EQUATIONS (3)
407. FOUNDATIONS OF ALGEBRA AND GEOMETRY (3)
408. APPLICATIONS OF MATHEMATICS (3)
- 409, 409X. THEORY OF PROBABILITY (3)
410. STATISTICAL METHODS (3)
411. FINITE DIFFERENCES (3)
417. VECTOR ANALYSIS (3)
419. ANALYTICAL MECHANICS (3)
- 420-421. ADVANCED CALCULUS (3 each)
424. LEAST SQUARES (2)
425. CURVE FITTING (1)
431. DIFFERENTIAL EQUATIONS (3)
441. THEORY OF EQUATIONS (3)
- 451-452. INTRODUCTION TO APPLIED MATHEMATICS (3-6 each)
471. FOUNDATIONS OF ALGEBRA (3)
472. FOUNDATIONS OF GEOMETRY (3)
481. VECTORS AND MATRICES (3)

MECHANICAL ENGINEERING

PROFESSOR NORMAN R. SPARKS, M.E.

Head of the Department

502. ADVANCED GAS TURBINES (3-6) Thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.
504. ADVANCED THERMODYNAMICS (3-6) Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisite: M.E. 3 or 104.
505. HEAT TRANSMISSION (3-6) Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412.

MECHANICAL ENGINEERING

506. MECHANICAL ENGINEERING SEMINAR (1-4) Advanced courses adapted to the individual requirements of graduates in mechanical engineering.
507. ADVANCED INTERNAL COMBUSTION ENGINES (3) Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504.
508. MECHANICAL ENGINEERING RESEARCH (1-15 per semester) Theoretical or experimental investigation in heat power or machine design.
510. FUEL INJECTION AND COMBUSTION IN DIESEL ENGINES (3-6) Characteristics and efficiency of various injection systems.
511. FUEL SPRAY LABORATORY (3) Laboratory study of fuel injection for the Diesel engine.
512. SCAVENGING OF TWO-STROKE CYCLE ENGINES (3) Design of ports, valves, blowers, intake and exhaust manifolds for proper scavenging and charging of engines, particularly two-stroke cycle Diesel engines; experimental technique in evaluating scavenging. Prerequisite: M.E. 413.
513. FUEL FEEDING DEVICES FOR INTERNAL COMBUSTION ENGINES (3) Carburetors and injection equipment for Otto and Diesel engines and for liquid-fuel turbines, including the required control devices.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401a,b,c,d. MECHANICAL ENGINEERING (3-12)
402. AIR CONDITIONING (3)
408. STEAM TURBINES (3)
409. GAS TURBINES (3)
410. STEAM POWER PLANTS (3)
- 411, 411X. REFRIGERATION (3)
- 412, 412X. FUNDAMENTALS OF HEAT TRANSFER (3)
413. INTERNAL COMBUSTION ENGINES (3)
416. RESISTANCE AND POWERING OF SHIPS (3)
417. THEORY OF ENGINEERING INSTRUMENTS (3)

MACHINE DESIGN

Consult PROFESSOR MAURICE S. GJESDAHL, M.S.

502. FRICTION AND LUBRICATION (3) The hydrodynamic theory of lubrication and methods of applying it to bearing design, together with a survey of methods of testing lubricants.
505. ADVANCED DYNAMICS OF MACHINES (3-6) Linear and torsional vibrations in and balancing of rotating and reciprocating machinery; exact analysis of stresses produced by these and other dynamic forces in machine parts. Prerequisites: Mchs. 12, M.E.Des. 8.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 402. DESIGN OF MACHINE TOOLS (3)
- 403. ADVANCED MACHINE DESIGN PROBLEMS (3)
- 404. MACHINE DESIGN ANALYSIS (3)

MECHANICAL ENGINEERING LABORATORY

Consult PROFESSOR EDGAR E. AMBROSIUS, M.S.

- 501. INVESTIGATION PROJECTS (2-6) Special experimental studies or investigations in mechanical engineering, adapted to individual requirements.

METALLURGY

PROFESSOR AMOS J. SHALER, Sc.D.

Chief of the Division

- 500. METALLURGICAL RESEARCH (3-15 per semester) Research on special topics; conferences, reading, and library work. Results may be embodied in a thesis. Prerequisites: Met. 411, 413.
- 501. METALLURGICAL PROBLEMS (1-6 per semester) Independent study of special problems in metallurgy. Prerequisites: Met. 411, 413.
- 502. METALLURGICAL SEMINAR (1 per semester) Conferences, reading, and reports. Required of all graduate students in metallurgy.
- 515. CORROSION OF METALS (3) Phenomena and theories of metallic corrosion; principles of alloy selection for engineering and structural uses in corrosive environments. Prerequisites: Met. 411, 413. *Professor Read*
- 516. MECHANICAL METALLURGY (3) Theories of plastic flow in polycrystalline metals; calculations of simple and combined stresses and application to metal forming and mechanical tests. Prerequisites: Met. 411, 413.
- 517. ADVANCED NONFERROUS METALLURGY (3) Theory of electrorefining, electro-winning, and processes involving the vapor phase; physical chemistry of roasting and leaching. Prerequisites: Met. 411, 413. *Professor Read*
- 518. CONSTITUTION OF METALLURGICAL SYSTEMS (3) Application of thermodynamic principles to study of heterogeneous equilibrium in alloy, slag, and slag-metal systems. Prerequisites: Met. 411, 413. *Professor Davis*
- 519. ADVANCED FERROUS METALLURGY (3) Physicochemical principles in the smelting and refining of iron and steel; slag control; solidification and primary forging of steel. Prerequisites: Met. 411, 413. *Professor Davis*
- 520. FOUNDRY METALLURGY (3) Principles of foundry metallurgy; application to

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foundry operations for various ferrous and nonferrous casting alloys. Prerequisites: Met. 411, 413. *Professor Lindsay*

521. ENGINEERING ALLOYS (3) Requirements and applications of industrial alloys: mechanical, thermal, electrical, and magnetic properties. Prerequisites: Met. 411, 413. *Professor Lindsay*

522. SOLID PHASE REACTIONS IN METALS (3) Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitations from solid solution, eutectoid, decomposition and order-disorder phenomena. Prerequisites: Met. 411, 413. *Professor Lindsay*

523. BEHAVIOR OF METAL CRYSTALS (3) Plastic action in single crystals of metals and in polycrystalline metals, theoretical crystal plasticity, recovery, and recrystallization, deformation and recrystallization textures, anisotropy in general. Prerequisites: Met. 411, 413.

525. METAL FINISHING (3) Metallic coatings and their metallurgical properties; theories and problems of application, utilization, and evaluation. Prerequisites: Met. 411, 413. *Professor Read*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 405. FERROUS METALLOGRAPHY (3)
- 406. NONFERROUS METALLOGRAPHY (3)
- 407. METALLURGICAL ENGINEERING I (3)
- 408. METALLURGICAL ENGINEERING II (3)
- 409. METALLURGICAL INVESTIGATIONS I (3)
- 410. METALLURGICAL INVESTIGATIONS II (3)
- 411. ADVANCED PHYSICAL METALLURGY (3)
- 412. EXPERIMENTAL METALLURGY (3)
- 413. ADVANCED CHEMICAL METALLURGY (3)

METEOROLOGY

PROFESSOR HANS NEUBERGER, D.Sc.
Chief of the Division

500. METEOROLOGICAL SEMINAR (1-3) Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteo. 421, 441, 451.

501. METEOROLOGICAL RESEARCH (3-15) Research work in physical, synoptic, dynamic meteorology; climatology. Prerequisites: a minimum of one year of physics, calculus, and differential equations, 15 credits in meteorology.

502. SELECTED TOPICS OF ADVANCED METEOROLOGY (2) Lectures, review, and discussion of current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology.

504. THEORETICAL AND DYNAMIC METEOROLOGY (3) Mathematical analysis of meteorological phenomena; theory of circulation; deformation fields. Prerequisite: Meteo. 452.

505. BIOCLIMATOLOGY (2) Climatic phenomena in their relation to life. Prerequisite: Meteo. 372.
506. ADVANCED METEOROLOGICAL ANALYSIS (2-6) Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteo. 421.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

421. SYNOPTIC METEOROLOGY I (3)
 422. SYNOPTIC METEOROLOGY II (3)
 431. SYNOPTIC METEOROLOGY LABORATORY I (2)
 432. SYNOPTIC METEOROLOGY LABORATORY II (2-10)
 441. PHYSICAL METEOROLOGY I (2)
 442. PHYSICAL METEOROLOGY II (2)
 451. DYNAMIC METEOROLOGY I (3)
 452. DYNAMIC METEOROLOGY II (3)
 453. PROBLEMS IN DYNAMIC METEOROLOGY (1)
 492. METEOROLOGICAL SEMINAR (2)

MINERAL ECONOMICS

PROFESSOR JOHN D. RIDGE, S.M., Ph.D.
Chief of the Division

500. MARKETING OF MINERALS AND MINERAL PRODUCTS (3-6) Research in mineral marketing problems.
501. RESEARCH IN MINERAL ECONOMICS (3-6) Investigation in specialized fields of research in mineral economics.
502. TECHNOLOGIC INFLUENCES (3-9) Relationship of technologic advancements to financial development of the mineral industries.
505. PROBLEMS OF MINERAL ECONOMICS (3-12) Determination of basic technologic-economic patterns of selected mineral industries. Prerequisite: Min.Ec. 87.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. SEMINAR (1)
 453. NONMETALLIC MINERALS (3)
 483. THE METALS AND THEIR ORES (3)
 484. THE SOLID FUELS (3)
 486. PETROLEUM AND NATURAL GAS ECONOMICS (3)
 490. MINERAL VALUATION (3)
 491. ANALYSIS OF MINERAL DATA (2)

MINERAL PREPARATION

MINERAL PREPARATION

PROFESSOR H. BEECHER CHARMBURY, M.S., Ph.D.
Chief of the Division

502. FROTH FLOTATION AND AGGLOMERATION (3) Intensive study of theory and applications of froth flotation and agglomeration. Prerequisite: Min.Pr. 405.

Professor Sun

504. MINERAL PREPARATION RESEARCH (3-10) Research work on specific problems in mineral preparation. Prerequisite: Min.Pr. 405 or 410.

Professor Charmbury and Staff

505. GRAVITY PROCESSES AND MISCELLANEOUS METHODS OF MINERAL PREPARATION (3) Intensive study of theory and applications of gravity, magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Min.Pr. 405.

Professor Mitchell

506. MINERAL PREPARATION PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Min.Pr. 405.

Professor Mitchell

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 400. MINERAL PREPARATION SEMINAR (1)
- 403. FLOWSHEETS OF MINERAL PREPARATION PLANTS (2)
- 404. PLANT LAYOUT AND DESIGN (3)
- 405. UNIT OPERATIONS (3)
- 406. MINERAL PREPARATION TESTING (2)
- 410. COAL PREPARATION (3)

MINERALOGY

PROFESSOR PAUL D. KRYNINE, Ph.D.
Chief of the Division

500. PHYSICAL MINERALOGY (3) Optical methods and measurement of optical constants of minerals.

Professors Krynine and Bates

- 501a. PETROLOGY (3-6) Microscopic study of rocks, emphasizing classification and genetic relationships.

Professors Krynine, Osborn, and Griffiths

- *502a. MINERALOGICAL RESEARCH (3-18) Original study of some mineralogical problem, results of which may be applied on the thesis requirements.

504. THEORETICAL MINERALOGY (2) Selected topics in crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena; laboratory studies of identification techniques including X-ray diffraction. Prerequisite: Min. 461.

Professor Bates

* Credits to be arranged, 3-9 per semester.

505. MINERALOGY SEMINAR (1-2) Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students.

Professors Krynine, Osborn, Bates, and Griffiths

†510. METAMORPHISM (2-6) Detailed review of chemical, mineralogical, and structural changes that take place during metamorphism. Prerequisite: Min. 483.

Professors Krynine, Osborn, Bates, and Griffiths

511. BASIC SEDIMENTOLOGY (3-4) Composition, texture, structure, mass properties of sediments; dynamic processes in complex natural systems; sedimentary stages: weathering, erosion, transport, deposition, and lithification. Prerequisite: Min. 483. Concurrent: Min. 513.

Professor Krynine

512. BASIC SEDIMENTOLOGY, CONTINUED (3-4) Diastrophism and tectonic background of sedimentation; depositional loci; classification of sediments: quartzites, graywackes, arkoses; chemical sediments; paleogeography, paleoclimatology, oil finding. Prerequisite: Min. 511. Concurrent: Min. 514.

Professor Krynine

513. METHODS OF ANALYSIS OF SEDIMENTS (2) Principles and practices used in analyzing sedimentary rocks for size, shape, and accessory (heavy) minerals. Concurrent: Min. 511.

Professor Griffiths

514. APPLIED SEDIMENTOLOGY (2) Design and control in analysis of sedimentary rocks; application of these techniques to industrial problems. Concurrent: Min. 512.

Professor Griffiths

515. MINERALOGY OF CLAYS AND OTHER FINE-GRAINED MATERIALS (2-3) Physical and chemical properties of clay minerals; importance and application of X-ray diffraction, differential thermal analysis, light and electron microscopy. Prerequisite: Min. 460.

Professors Bates and Griffiths

516. PETROLOGY OF FINE-GRAINED SEDIMENTS (2-3) Fine-grained sedimentary rocks and their industrial applications. Prerequisite: Min. 515.

Professors Griffiths and Bates

†517. EUROPEAN SEDIMENTS (1-6) Interpretative microscopic and hand specimen study of selected rock suites from Europe and Asia; correlation with paleogeographic and tectonic data. Prerequisites: Min. 512, 514.

Professor Krynine

†518. AMERICAN SEDIMENTS (2-8) Thin section, heavy residue, textural and field data of arkoses, graywackes, quartzites, and carbonates from representative North American sedimentary provinces. Prerequisites: Min. 512, 514, 516.

Professor Krynine

§519. OIL RESERVOIR PETROLOGY (2-6) Petrographic fundamentals controlling porosity, storage capacity, oil accumulation, effective permeability, fluid yield and retention, exploration and production methods. Prerequisites: Min. 512, 514, 516.

Professors Krynine and Griffiths

520. STUDY OF ACCESSORY MINERALS (2-4) Detailed study of accessory (heavy) minerals; their significance in problems of provenance, petrogenesis, mineral

† Credits to be arranged, 2-4 per semester.

‡ Credits to be arranged, 1-3 per semester.

§ Credits to be arranged, 2-3 per semester.

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stratigraphy, and paleogeography. Prerequisites: Min. 511, 512, 513, 514.

Professor Griffiths

521. COLOR IN MINERALS (1-2) Nature of light absorption as a function of chemical composition for solutions, glasses, and minerals.

Professor Weyl

§522. THE ELECTRON MICROSCOPE IN MINERALOGICAL AND GEOLOGICAL PROBLEMS (2-6) Laboratory investigation of geological subjects at high magnification; correlation of data with those obtained by other methods of study.

Professor Bates

§523. X-RAY DIFFRACTION STUDIES OF MINERALS (2-6) Investigation of mineralogical problems with X-rays. Practicum includes preparation of samples, use of X-ray apparatus, and interpretation of patterns. Prerequisite: Min. 461.

Professor Bates

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

460. PHYSICAL MINERALOGY (3)

Professor Wright

461. DESCRIPTIVE MINERALOGY (4)

Professor Bates

483. PETROGRAPHY (4)

Professor Griffiths, Mr. Thornton

MINING

PROFESSOR ARNOLD W. ASMAN, B.Sc.

Chief of the Division

500. MINING SEMINAR (2) Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering.

501. MINE ENGINEERING (3) Mine mechanization problems. Selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488.

504. MINING RESEARCH (3-10 per semester) Research work on specific problems in physics of mining and mine mechanization. Prerequisite: Mng. 481.

506. MINE AND MINE PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499.

520. MINE PLANNING USING CYCLE STUDIES (3-6) Highly productive cycles of mine section operation are developed by use of time and method studies of the various sub-cycles involved. Prerequisite: Mng. 72.

521. MATHEMATICAL ANALYSIS OF MINE LAYOUTS (3) Proportioning layouts in regard to mineral available, distances, and centroids of mining areas; incremental and sub-cycle costs. Prerequisite: Mng. 488.

522. ROCK MECHANICS (3-6) Detailed study of the physical properties of rocks as affecting the design of underground openings; testing procedures, calculations, and design. Prerequisite: Mng. 499.

§ Credits to be arranged, 2-3 per semester.

523. **MINE DUSTS (3)** Detailed studies of methods of collecting, sampling, and determining amount, size, and mineral content of dust in mine atmospheres; methods of dust control. Prerequisite: Mng. 481.
524. **UNDERGROUND MINING POWER DISTRIBUTION SYSTEMS (3-6)** Calculations involved in the design of power applications and systems for mines; electrical, compressed air; Diesels; package power for extremely gassy conditions; sectionalizing; loads and load centers. Prerequisite: Mng. 488.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. **MINE SAFETY ENGINEERING (2)**
 481. **PHYSICS OF MINING (4)**
 484. **MINE COST CONTROL (2)**
 488. **ADVANCED MINE MECHANIZATION (3)**
 494. **MINE MANAGEMENT ENGINEERING (3)**
 499. **ADVANCED MINING DESIGN (2)**

MUSIC

PROFESSOR HUMMEL FISHBURN, M.A., Mus.D.

Head of the Department

- 503-506. **ADVANCED STRINGED INSTRUMENTS (3 per course)** Study, repertoire building, and recital performance. Prerequisite: Music 103-106. Fee \$25 per course.
Professor Karham
- 511-514. **ADVANCED PIANO (3 per course)** Piano literature of all periods; stress laid on developing technique and preparing for public performance. Fee \$25 per course.
Professor Brinsmaid
- 531-534. **ADVANCED ORGAN (3 per course)** Study, repertoire building, and recital performance. Prerequisite: Music 31-34. Fee \$30 per course. *Professor Ceiga*
- 558-561. **FREE COMPOSITION (3 per course)** Composition: vocal and instrumental, standard or modern idioms. Prerequisite: 18 credits in harmony, counterpoint, and piano.
Professor Henninger
563. **FREE ARRANGING (3)** Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisite: 18 credits in harmony, including 3 of orchestration.
Professor Fishburn
567. **THE LITERATURE OF THE ORCHESTRA (3)** The suite, symphony, tone poem, and overture from the point of view of appreciation, form, and orchestration. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra.
Professor Fishburn

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

407. **PIANO REPERTOIRE (3)** *Professor Brinsmaid*

MUSIC

408. VOCAL LITERATURE (3)
410. MUSIC OF THE 20TH CENTURY (3)
411. LITERATURE OF THE VIOLIN (3)
429-432. SINGER'S STYLE AND INTERPRETATION (3 per course) Fee \$25 per course.
456. ELEMENTARY COUNTERPOINT (3) *Professor Taylor*
466. ADVANCED CONDUCTING (3) *Professor Henninger*
Professor Gullo

MUSIC EDUCATION

PROFESSOR HUMMEL FISHBURN, M.A., Mus.D.
Head of the Department

500. MUSIC EDUCATION SEMINAR (3-6) Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems.
569. PRESENT-DAY TRENDS IN INSTRUMENTAL MUSIC (3) New methods and materials for band, orchestra, and ensembles.
571. VOCAL PEDAGOGY (3) Detailed study of vocal problems met in public schools, elementary through high school; vocal class pedagogy and literature; daily voice training. Prerequisites: Mus.Ed. 48 and teaching experience.
572. INSTRUMENTAL PEDAGOGY (3-6) Research problems in band and orchestra. Prerequisite: Mus.Ed. 54 or practical experience.
573. THE MATERIALS OF APPRECIATION (3) Methods and materials for development of music appreciation in elementary and secondary schools. Prerequisites: Music 5, teaching experience.
- 574a,b. PRESENT-DAY TRENDS IN MUSIC EDUCATION (3-6) Present-day music education materials and methods (elementary and secondary levels) in relation to modern educational philosophy; emphasis upon practical problems presented by members of the class. Prerequisites: Mus.Ed. 48, teaching experience.
575. THE JUNIOR HIGH SCHOOL MUSIC CURRICULUM (3) Instructional materials, procedures, curricular and extracurricular activities, integration with other subjects.
576. MUSIC SUPERVISION (3) Current educational procedures in training music supervisors.
580. FIELD PROJECTS IN JUNIOR AND SENIOR HIGH SCHOOL MUSIC (3) Curricular problems to be carried on under actual school conditions; individual work under supervision. Prerequisites: teaching experience, 30 credits of graduate study.
590. THESIS (3-15)
594. PEDAGOGY OF EAR TRAINING (3) Materials and methods for training the listener to grasp, understand, and write what is heard from melody to four-part harmony. Prerequisite: 12 credits in ear training and/or harmony.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401. MUSIC IN THE RURAL AREA (3)
- 462. PEDAGOGY OF THEORY (3)
- 468. THE TEACHING OF PIANO (3)
- 469. BAND AND ORCHESTRA TECHNIQUE (3)
- 470. CHORAL TECHNIQUE (3)
- 475. OBJECTIVES AND PROBLEMS IN ELEMENTARY MUSIC EDUCATION (3)

PETROLEUM AND NATURAL GAS

PROFESSOR JOHN C. CALHOUN, M.S., Ph.D.
Chief of the Division

- 500a. PETROLEUM AND NATURAL GAS ENGINEERING RESEARCH (3-9 per semester)
- 501. ENERGETICS OF PETROLEUM ENGINEERING (3) Applications of thermodynamics to special problems in production of petroleum and natural gas. Prerequisite: M.E. 2.
- 502a. PETROLEUM AND NATURAL GAS ENGINEERING SEMINAR (3-9) Intensive study of one or several phases of petroleum engineering.
- 503. THE FLOW OF HOMOGENEOUS FLUIDS THROUGH POROUS MEDIA (3) Flow and pressure distributions for various geometric patterns for steady and unsteady states. Prerequisite: Math. 431.
- 504. WATER FLOODING (3-6) Continuation of Pet.E. 485 with emphasis on special problems. Prerequisite: Chem. 40.
- 506. ADVANCED PETROLEUM ENGINEERING (3) Advanced problems in petroleum and natural gas production. Prerequisites: Chem. 41, Pet.E. 310.
- 507. CONDENSATE FIELDS (2) Retrograde condensation phenomenon of hydrocarbon mixtures at high pressures; literature on condensate fields; production methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: Pet.E. 501.
- 508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Principles of colloidal activity applied to control of properties of clay slips, drilling fluids, and similar suspensions. (In co-operation with the Ceramics staff.) Prerequisite: Chem. 41.
Professor Henry
- 509. ADVANCED PETROLEUM ENGINEERING DESIGN (2) Continuation of Pet.E. 320. Projects in selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: Pet.E. 320.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 420. EXPLOITATION AND DEVELOPMENT ENGINEERING (3)
- 481. NATURAL GAS AND GASOLINE PLANTS (4)

PETROLEUM AND NATURAL GAS

- 483. NATURAL GAS LABORATORY (1)
- 485. SECONDARY RECOVERY (3)
- 490. ADVANCED CORE TESTING (3)

PHILOSOPHY

PROFESSOR JOHN M. ANDERSON, M.A., Ph.D.
Head of the Department

- 500a,b. ETHICAL SEMINAR (2-6) Critical study of some phase of ethical fact and theory.
- 501a,b,c,d. PHILOSOPHY SEMINAR (2-12) Meets the demand for advanced study in special fields of philosophical thought.
- 502. THEORY OF EPISTEMOLOGY (3) Systematic and critical analysis of some aspect of contemporary epistemology.
- 503. LOGIC (3) The logical basis of mathematics and its ultimate nature.
- 504. SOCIAL AND POLITICAL PHILOSOPHY (3) Critical study of basic problems in their historical and functional setting.
- 505. IDEALS OF WESTERN CIVILIZATION (3) Analysis of contemporary ideals in terms of their Graeco-Judean bases.
- 507. SEMINAR IN HISTORY OF PHILOSOPHY (3-12) Concentrated study of some work or problem in the history of philosophy.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401. RELIGIOUS PHILOSOPHY OF THE GREAT REFORMERS (3)
- 405. PHILOSOPHY OF ST. AUGUSTINE (3)
- 408. ADVANCED SOCIAL AND POLITICAL PHILOSOPHY (3)
- 409. PHILOSOPHY OF ST. THOMAS AQUINAS (3)
- 415. THE PHILOSOPHY OF KANT (3)
- 418. RECENT AND CONTEMPORARY PHILOSOPHY (3)
- 426. METAPHYSICS (3)
- 427. ADVANCED ETHICS (3)
- 428. ADVANCED LOGIC (3)
- 430. HONORS COURSE IN PHILOSOPHY (3)

PHYSICAL EDUCATION

Consult PROFESSOR LLOYD M. JONES, M.A., Ph.D.

- 500. PROBLEMS IN PHYSICAL EDUCATION (3) Prerequisite: Ph.Ed. 455.
- 522. ORGANIZATION AND ADMINISTRATION OF PHYSICAL EDUCATION IN COLLEGES AND UNIVERSITIES (3) Administration of physical education in college; credits, sched-

ules, excuses, records, reports, budgets, classification, tests, staff, and facilities.
Prerequisite: Ph.Ed. 491. *Professor Bedenk*

523. ADMINISTRATION OF COLLEGE ATHLETICS (3) Eligibility, schedules, managerial systems, relationships of athletics to the physical education program and to education in general. Prerequisite: Ph.Ed. 491. *Professor Bedenk*

526. ATHLETIC PROBLEMS IN SCHOOLS (3) Practical problems which result from administration of athletics in schools. Reports on some aspects of athletics required. Prerequisite: Ph.Ed. 460. *Professor Bedenk*

528. PROFESSIONAL EDUCATION OF TEACHERS OF HEALTH AND PHYSICAL EDUCATION (3) Health and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems. Prerequisite: Ph.Ed. 491. *Professor Jones*

529. SUPERVISION OF PHYSICAL EDUCATION IN SCHOOLS (3) Methods and policies of the school supervisor of physical education; conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher. Prerequisites: Ph.Ed. 452, 453, 491. *Professor Jones*

530. RESEARCH TECHNIQUES IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Ph.Ed. 490. *Professor Lawther*

531. RESEARCH IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Ph.Ed. 530. *Professor Jones*

532. TESTS AND MEASUREMENTS IN PHYSICAL EDUCATION (3) Critical study of tests and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Ph.Ed. 490. *Professor Jones*

534. STUDIES IN CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION (3) Principles and methods of curriculum building in physical education; different psychological and educational points of view, organizing a course of study committee, making units of instruction. Prerequisites: Ph.Ed. 452, 453, 454. *Professor Jones*

535. MODERN FOREIGN SYSTEMS OF PHYSICAL EDUCATION (3) Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Ph.Ed. 534, 595. *Professor Speidel*

536. SCIENTIFIC METHODS IN ATHLETIC COACHING (3) Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Ph.Ed. 460. *Professor Lawther*

550. SEMINAR IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (1-6) Open only to students preparing approved theses and dissertations. *Professor Jones and Staff*

555. RELATIONSHIPS OF PHYSICAL EDUCATION TO THE EXACT SCIENCES (3) *Professor Lucey*

560. ADMINISTRATIVE PROBLEMS OF PHYSICAL EDUCATION IN SCHOOLS (3) Solutions to problems emerging from the administration of physical education in schools, fitting physical education into the school's schedule, awards and budgets. Prerequisite: Ph.Ed. 491. *Professor Jones*

PHYSICAL EDUCATION

581. PROBLEMS IN BODY MECHANICS (3) Certain aspects of human motion and body segmental alignment; analysis of human gait, and the dynamic adaptation of the spine, thorax, and pelvis to external physical forces. Prerequisite: Hl.Ed. 244, Ph.Ed. 399. *Professor Lucey*
595. PHILOSOPHY OF HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Hl.Ed. 453 or Ph.Ed. 491 or Recr. 465. *Professor Jones*
598. THESIS (1-6)
599. DISSERTATION (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

424. MODERN TRENDS IN HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS (3) *Professor Jones*
- 429S. THE MODERN DANCE IN EDUCATION (3) *Professor Briant*
- 431S. COACHING OF ADVANCED BASEBALL (3) *Professor Bedenk*
- 436S. COACHING OF ADVANCED FOOTBALL (3) *Professor Engle*
- 437S. COACHING OF ADVANCED BASKETBALL (3) *Professor Gross*
- 438S. COACHING OF ADVANCED TRACK (3) *Professor Werner*
- 439S. COACHING OF ADVANCED SOCCER (3) *Professor Jeffrey*
- 440S. COACHING OF ADVANCED GYMNASTICS (3) *Professor Wettstone*
- 441S. ADVANCED COACHING OF ATHLETICS FOR MEN (1-11)
- Unit A. Basketball (1) *Professor Gross*
- Unit B. Football (1) *Professor Engle*
- Unit C. Track and Field (1) *Professor Werner*
- Unit D. Baseball (1) *Professor Bedenk*
- Unit E. Wrestling (1) *Professor Speidel*
- Unit F. Soccer (1) *Professor Jeffrey*
- Unit G. Swimming (1) *Mr. Gutteron*
- Unit H. Gymnastics (1) *Professor Wettstone*
- Unit I. Boxing (1) *Mr. Sulkowski*
- Unit J. Lacrosse (1) *Professor Thiel*
- Unit K. Fencing (1) *Professor Meyer*
- 449S. ADVANCED TEACHING OF SPORTS AND RHYTHMICS (1-11)
- Unit A. Soccer and Speedball (1) *Professor Lucey*
- Unit B. Basketball (1) *Professor Lucey*
- Unit C. Field Hockey (1) *Professor Lucey*
- Unit D. Archery (1) *Professor Haidt*
- Unit E. Swimming (1) *Professor Bleich*
- Unit F. Rhythmics for Children (1) *Professor Briant*
- Unit G. Modern Dance and Accompaniment (1) *Professor Briant*
- Unit H. Early American Country Dancing and Social Dancing (1) *Professor Briant*
- Unit I. Tennis (1) *Professor Lucey*
- Unit J. Badminton (1) *Professor Lucey*
- Unit K. Golf (1) *Mr. Rutherford*
- 452S, 452X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE ELEMENTARY SCHOOL (3) *Professor Speidel*
- 453S, 453X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE HIGH SCHOOL (3) *Professor Bischoff*

454. THE NATURAL PROGRAM OF PHYSICAL EDUCATION ACTIVITIES, APPLIED (3)
Professor Bischoff
455. SCIENTIFIC METHOD IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Jones*
460. METHODS AND PRINCIPLES OF ATHLETIC COACHING (3) *Professor Lawther*
- 466S. VISUAL INSTRUCTION IN ATHLETICS (3) *Professor Conger*
- 471S. HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS FOR THE SCHOOL ADMINISTRATOR (3) *Professor Jones*
- Unit A. Athletics in the Schools (1)
- Unit B. Health Education in the Schools (1)
- Unit C. Physical Education and Recreation in the Schools (1)
480. ADVANCED ANATOMY AND PHYSIOLOGY, APPLIED (3) *Professor Lucey*
- 482, 482X. POSTURE EDUCATION IN THE SCHOOLS (3) *Miss Phillips*
- 488S. THE ADMINISTRATION OF PHYSICAL EDUCATION AND ATHLETICS FOR WOMEN (3) *Professor Haidt*
489. INTRAMURAL ATHLETICS (3) *Professor Bischoff*
490. INTRODUCTION TO TESTS AND MEASUREMENTS IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Jones*
491. ORGANIZATION AND ADMINISTRATION OF HEALTH AND PHYSICAL EDUCATION IN SCHOOLS (3) *Professor Jones*

PHYSICS

PROFESSOR D. C. DUNCAN, M.A., Ph.D.
Acting Head of the Department

- 501a,b,c,d,e. PHYSICS RESEARCH (1-15 per semester) Original work to obtain material for a thesis. May be continued in successive semesters as Phys. 501b, 501c, etc. to a maximum of 45 credits.
507. THEORETICAL THERMODYNAMICS (3) Mathematical treatment of the principles of thermodynamics.
509. PHYSICS SEMINAR (1) Selected topics from current physical research critically examined and discussed. May be continued in successive semesters as Phys. 509a, 509b, 509c.
517. KINETIC THEORY (3) The Maxwell-Boltzmann law, Brownian movements, specific heats, and other selected topics. Prerequisites: Phys. 411, Math. 431.
521. CRYSTAL STRUCTURE (3) Solution of the structure of crystals by X-ray methods. Available for major credit in either physics or chemistry.
522. ADVANCED CRYSTAL ANALYSIS (3) Continuation of Phys. 521, including the application of crystal structure studies to physical, chemical, and metallurgical problems. Available for major credit in either physics or chemistry.
530. INTRODUCTION TO THEORETICAL PHYSICS (3) Application of higher mathematics to problems in various fields of physics. Prerequisites: Math. 431, Phys. 285.
531. THEORETICAL PHYSICS (3) Continuation of Phys. 530.

PHYSICS

533. THEORY OF SOUND (3) Mathematical treatment of the theory of sound. Prerequisite: Phys. 530.
553. NUCLEAR PHYSICS (3) Mathematical course in nuclear physics. Prerequisite: Phys. 562.
- 557-558. ELECTRICITY AND MAGNETISM (3 each) Treatment of the mathematical theory of electricity and magnetism. Prerequisite: Phys. 467.
560. ADVANCED PHYSICAL MEASUREMENTS (1-18) Offers opportunity for advanced work in various fields of physics.
561. DE BROGLIE WAVES AND QUANTUM MECHANICS (3) Introduction to modern interpretation of atomic structure and radiation phenomena, based upon the de Broglie and Schrodinger wave theory. Prerequisite: Phys. 531.
562. WAVE MECHANICS IN MODERN PHYSICS (3) Continuation of Phys. 561. Theory of atomic and simple molecular spectra, Zeeman and Stark effect, theories of metallic conductivity and thermionic emission, etc. Prerequisite: Phys. 561.
571. ATOMIC STRUCTURE (3) Recent work in atomic and subatomic physics.
572. SPECTROSCOPY (3) Atomic and molecular spectra, both emission and absorption methods of excitation, radiation and ionization potentials, spectral series, fine structure, spectra of ionized and stripped atoms.
575. PROBLEMS IN MODERN PHYSICS (1-3) Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 456.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. INTERMEDIATE ELECTRICITY AND MAGNETISM (4)
402. ELECTRONICS (4)
404. ELECTRONIC MEASUREMENTS (2-4)
411. THEORETICAL MECHANICS (3)
417. THE TEACHING OF PHYSICS (3)
420. INTERMEDIATE HEAT (3)
- 433S. INTERMEDIATE MECHANICS AND FLUID PHYSICS (3)
- 435S. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
- 437S. INTERMEDIATE HEAT, SOUND, AND LIGHT (3)
- 439S. ELEMENTARY SURVEY OF MODERN PHYSICS (3)
- 441S. DEMONSTRATION EQUIPMENT (3)
443. INTERMEDIATE ACOUSTICS (3)
444. MEASUREMENTS IN ACOUSTICS (2)
- 454, 454X. ATOMIC AND NUCLEAR PHYSICS (3)
456. ATOMIC AND NUCLEAR PHYSICS (3)
457. EXPERIMENTAL ATOMIC PHYSICS (2)
458. INTERMEDIATE OPTICS (4)
461. THEORETICAL MECHANICS (3)
467. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
- 473-474. BIOPHYSICS (3 each)
477. X-RAY ANALYSIS OF SOLIDS AND LIQUIDS (3)

POLITICAL SCIENCE

PROFESSOR R. WALLACE BREWSTER, M.A., Ph.D.

Head of the Department

- 500. SEMINAR IN POLITICAL SCIENCE (3-12) Subject to be announced.
- 505. SEMINAR IN ADVANCED AMERICAN GOVERNMENT (3-12)
- 508. RESEARCH IN PUBLIC ADMINISTRATION (3-12)
- 509. RESEARCH TECHNIQUES IN POLITICAL SCIENCE (3)
- 510. POLITICAL AND ADMINISTRATIVE PROBLEMS IN PENNSYLVANIA (3-6)
- 512. COMPARATIVE GOVERNMENT (3-12)
- 515. INTERNATIONAL RELATIONS (3-6)
- 517. INTERNATIONAL ORGANIZATION (3-6)
- 519. PUBLIC ADMINISTRATION (3-6)
- 521. POLITICAL THEORY (3-6)
- 535. GOVERNMENT REGULATION (3-6)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 411. AMERICAN POLITICAL THEORY (3)
- 413. GOVERNMENT AND FOREIGN POLICY OF THE SOVIET UNION (3)
- 415. INTERNATIONAL ORGANIZATION (3)
- 416. INTERNATIONAL LAW (3)
- 417. MUNICIPAL GOVERNMENT (3)
- 419. PUBLIC ADMINISTRATION (3)
- 421. MODERN POLITICAL THEORIES (3)
- 424S. STATE GOVERNMENT IN THE UNITED STATES (3)
- 427. PUBLIC OPINION AND PROPAGANDA (3)
- 428. PENNSYLVANIA LOCAL GOVERNMENT (3)
- 429. PENNSYLVANIA LOCAL ADMINISTRATION (3)
- 431. ANCIENT AND MEDIEVAL POLITICAL THEORIES (3)
- 432. CURRENT POLITICAL TRENDS AND PROBLEMS IN THE UNITED STATES (3-9)
- 433. LABOR AND WELFARE LEGISLATION AND ADMINISTRATIVE PROBLEMS (3)
- 435. GOVERNMENT HOUSING, PLANNING, AND PUBLIC WORKS (3)
- 442. AMERICAN FOREIGN POLICY (3)
- 444. GOVERNMENT REGULATION (3)
- 445. ADMINISTRATIVE LAW (3)
- 446. JUDICIAL SYSTEMS (3)
- 450. GOVERNMENT AND FOREIGN POLICIES OF BRITAIN AND THE COMMONWEALTH (3)
- 456. GOVERNMENTS AND FOREIGN POLICIES OF LATIN AMERICA (3)
- 458. GOVERNMENTS AND FOREIGN POLICIES OF THE FAR EAST (3)
- 499X. FOREIGN STUDY IN GOVERNMENT (2-6)

PORTUGUESE

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Acting Head of the Department of Romance Languages

- 571. SEMINAR IN PORTUGUESE LITERATURE (3-6) Prerequisite: Port. 4.

POULTRY HUSBANDRY

PROFESSOR ERNEST W. CALLENBACH, M.S.

Head of the Department

502. ADVANCED POULTRY NUTRITION (2-4) Prerequisite: P.H. 3. *Professor Murphy*
503. ADVANCED POULTRY FARM MANAGEMENT (2-4) Prerequisite: P.H. 8.
Professor Bressler
504. ADVANCED MARKET POULTRY AND EGGS (2-4) Prerequisites: P.H. 1, 7; Agr.Ec.
33 or 2 additional credits in poultry husbandry. *Professor Margolf*
505. RESEARCH IN POULTRY HUSBANDRY (1-15 per semester) Prerequisite: 9 credits
in poultry husbandry. *Professor Callenbach and Staff*
506. SEMINAR IN POULTRY HUSBANDRY (1-6) *Professor Callenbach and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

412. POULTRY BREEDING (3) *Professor Maw*

PSYCHOLOGY

PROFESSOR CLARENCE R. CARPENTER, M.A., Ph.D.

Head of the Department

500. SEMINAR: INTRODUCTION TO RESEARCH METHODS (1) Prerequisite: 12 credits
in psychology.
501. ADVANCED PSYCHOLOGY (3) Comprehensive study of general psychology.
Prerequisite: 9 credits in psychology. *Professor Lepley*
502. ADVANCED EDUCATIONAL PSYCHOLOGY (2-4) Psychological theories and prin-
ciples underlying educational theories and practices. Prerequisites: Psy. 14 or
414; Ed. 31 or teaching experience. *Professor van Ormer*
503. PHYSIOLOGICAL PSYCHOLOGY (2-6) Correlations between structure and func-
tion of nervous system and human consciousness; laws and theories in fields of
sensation, attention, association, affection, and thought. Prerequisite: 9 credits
in psychology. *Professor DeCamp*
504. COMPARATIVE PSYCHOLOGY (2-4) Behavior from standpoint of phylogenetic
growth and development; biological implications; comparison of different types of
animals, including man. Prerequisite: 9 credits in psychology.
Professor Carpenter
505. RESEARCH PROBLEMS IN PSYCHOLOGY (1-15) Prerequisite: 12 credits in psy-
chology.
506. CLINICAL PSYCHOLOGY (1-6) Procedures used in the Psychology Clinic.
Limited to students enrolled in Psy. 560. Prerequisites: Ed. 70 or Psy. 471; Psy.
550 or 551. *Professor Snyder*

509. **ADVANCED THEORY OF LEARNING AND HABIT FORMATION (2-3)** Critical evaluation of major theories of learning: Hull, Guthrie, Tolman, Lewin. Application of learning theory to major problems in psychology. Prerequisite: Psy. 4 or 407 or 414. *Professor Grosslight*
510. **HISTORY OF PSYCHOLOGY (3)** Theoretical systems, experiments, and personalities in development of modern psychology until about 1920. Prerequisite: 9 credits in psychology. *Professor Carpenter*
511. **CONTEMPORARY AMERICAN PSYCHOLOGY (2-3)** Current systems or schools of psychology with comparative study and critical analysis; points of view as presented by recognized leaders. Prerequisite: 9 credits in psychology. *Professor Lepley*
513. **EDUCATIONAL PSYCHOLOGY: DIFFERENTIAL (2)** Causes of differences in achievement and personality; psychological implications of methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*
514. **EDUCATIONAL PSYCHOLOGY: LEARNING (2)** Experimentally determined facts about the learning process; synthesis of main theories of learning; application of principles related to: motivation, practice, retention, transfer, meaning, and problem solving. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*
515. **ADVANCED STATISTICS IN PSYCHOLOGY AND EDUCATION (3)** Sampling, tests of significance, factor analysis, analysis of variance and other advanced statistical methods; application of statistical methods to practical problems. Prerequisite: Psy. 415 or Ed. 574. *Professor Kurtz*
517. **PSYCHOLOGY OF ATTITUDES AND OPINIONS (3)** Acquisition and control of attitudes and opinions, including beliefs, convictions, biases, prejudices, and ideologies as determinants of action. Prerequisite: 18 credits in psychology, including Psy. 417, 422, 437. *Professor Carpenter*
518. **PROJECTS IN EXPERIMENTAL PSYCHOLOGY (2-4)** Individual experimental projects; seminars on experimental design and instrumentation. Prerequisite: Psy. 407.
521. **RESEARCH PROBLEMS IN INDUSTRIAL PSYCHOLOGY (2-6)** Actual industrial personnel problems in laboratory and industrial plants: monotony, fatigue, psychological selection, and training procedures. Prerequisites: Psy. 21, 431. *Professor Kinsley Smith*
522. **ADVANCED PSYCHOLOGICAL MARKETING RESEARCH TECHNIQUES (3)** Current literature; special questionnaire designs to test consumer reaction to products, advertising, and company policies from psychological standpoint; scale analysis; consumer motivation. Prerequisite: 15 credits in psychology, including Psy. 15, 21, 422. *Professor Guest*
525. **SAMPLING DESIGNS IN MARKET AND OPINION RESEARCH (3)** Techniques in selection of samples for accurate representation of human populations; special emphasis on probability sampling. Prerequisites: Psy. 15, 21, 422.
526. **ANALYSIS AND PRESENTATION OF MARKET AND OPINION RESEARCH DATA (3)** Classification and cross-tabulation of data as an aid in understanding research;

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- analysis of opinion data by punch-card equipment. Prerequisites: Psy. 15, 21, 422.
528. **OPINION RESEARCH ADMINISTRATION (3-6)** Practicum in planning, development of techniques, and administration of the sample survey. Prerequisite: Psy. 428. *Professor Guest*
- 529 (Ch.Fm. 529). **SEMINAR IN CHILD DEVELOPMENT (1-6)** Readings and reports on recent findings in child development. Prerequisites: Ch.Fm. 429, 430, or Psy. 411 or 425.
534. **APPLICATIONS OF PSYCHOLOGY IN BIO-MECHANICS (2)** Experimental studies of psychological factors affecting design and operation of machines. Prerequisites: Psy. 3 and 4, or 501. *Professor Kinsley Smith*
539. **MOTIVATION AND EMOTION (3)** Systematic status of instinct, drive, motive, will, purpose; methodology and results of physiological, experimental, and clinical investigation of basic drives. Prerequisites: Psy. 3, 4. *Professor Kendon Smith*
540. **CLINICAL PSYCHOLOGY SEMINAR (1-6)** Seminar on current problems in clinical psychology. Prerequisite: Psy. 482.
541. **DYNAMICS OF HUMAN ADJUSTMENT (3)** Seminar on motivation of human behavior, frustration, and mechanisms of adjustment; normal behavior is stressed. Prerequisite: Psy. 437. *Professor Bernreuter*
542. **PSYCHOPATHOLOGY (3)** Covers basic, developmental, human, experimental reactions, showing how normal and pathological character trends and deviations evolve; basic reasons for and applications of psychotherapeutic methods. Prerequisite: Psy. 412 or 437. *Professor Lott*
543. **COUNSELING TECHNIQUES (2)** Survey of psychotherapeutic methods; history, theory, and methods employed; case illustrations. Prerequisite: Psy. 482. *Professor Snyder*
550. **PSYCHOMETRICS: BINET (2)** Measurement of intelligence by Stanford revision of the Binet-Simon technique; demonstrations, lectures; practice administering tests; observations of student by instructor. Prerequisite: Psy. 471.
551. **PSYCHOMETRICS: POINT SCALES (2)** Measurement of intelligence by individual nonverbal techniques: Arthur, Wechsler-Bellevue, and others; demonstrations, lectures, and practice administering tests under observation. Prerequisite: Psy. 471.
552. **PSYCHOMETRICS: PRESCHOOL (2)** Measurement by individual preschool scales: Merrill-Palmer, Minnesota, California First Year; demonstrations, lectures, and practice in administering tests under observation. Prerequisite: Psy. 551.
553. **PSYCHOMETRICS: ADVANCED (2)** Measurement of intelligence, social maturity, and other characteristics; demonstration, lectures, and practice in administering tests; observations by instructor. Prerequisite: Psy. 550. *Professor Bernreuter*
554. **PSYCHOMETRICS: SENSORY (2-3)** Measurement of auditory and visual acuity and defects; psychophysiological theory; demonstrations, lectures, and practice in administering and interpreting tests under observation. Prerequisite: Psy. 4.
555. **PSYCHOMETRICS: RORSCHACH ADMINISTRATION (3)** Introduction to theory of

projective tests; supervised practice in administering and scoring of the Rorschach test. Prerequisite: Psy. 550 or 551. *Professor Guthrie*

556. PSYCHOMETRICS: RORSCHACH INTERPRETATION (3) Study of current literature and supervised practice. Prerequisite: Psy. 555. *Professor Guthrie*

557. PSYCHOMETRICS: ADVANCED PROJECTIVE TECHNIQUES (2-3) Survey of common projective techniques other than the Rorschach, with supervised practice. Prerequisite: Psy. 556. *Professor Guthrie*

560. CLINICAL PRACTICUM (2-3) Applied experience in techniques of clinical psychology; case work in the Psychology Clinic. Prerequisites: Psy. 482, 550, 551.

561. CLINICAL PRACTICUM: ELEMENTARY SCHOOL (1-3) Experience in the Psychology Clinic and public schools in learning and adjustment problems; diagnosis and remedial work; pertinent school laws and practices. Prerequisites: Psy. 560 and Ed. 70, or Ed. 432g or 470.

562. CLINICAL PRACTICUM: VOCATIONAL GUIDANCE (1-3) Practical experience in the Psychology Clinic on high school, college, and adult vocational guidance cases; staff meetings; seminar on techniques and materials. Prerequisite: Psy. 560 or Ed. 502.

563. CLINICAL PRACTICUM: MARITAL COUNSELING (1-3) Experience in the Psychology Clinic on premarital and marital adjustment; seminar on techniques of adjustment and development of sexual and emotional maturity in marriage. Prerequisite: Psy. 560. *Professor Adams*

564. CLINICAL PRACTICUM: PERSONAL ADJUSTMENT COUNSELING (2-3) Advanced practicum with experience in counseling of personal adjustment problems referred to the Psychology Clinic. Prerequisite: Psy. 565. *Professor Snyder*

565. CLINICAL PRACTICUM: NONDIRECTIVE COUNSELING (3) Practical experience in application of the nondirective method, along with systematic theoretical study of the method. Prerequisites: Psy. 543, 560. *Professor Snyder*

566. CLINICAL PRACTICUM: HYPNOTHERAPY (1-3) Practical experience in the Psychology Clinic in use of hypnotherapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

567. CLINICAL PRACTICUM: PLAY THERAPY (1-3) Practical experience in the Psychology Clinic in use of play therapy with young children; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

568. CLINICAL PRACTICUM: GROUP THERAPY (2) Practical experience in the Psychology Clinic in use of group methods for treatment of personal maladjustments; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565.

569. CLINICAL PRACTICUM: ADVANCED NONDIRECTIVE (2) Practical experience in the Psychology Clinic in advanced nondirective therapy techniques; staff meetings; case conferences. Prerequisite: Psy. 565.

574. MENTAL DEFICIENCY (3) Causes of mental deficiency; diagnosis, training, and care of mental defectives. Prerequisites: Psy. 414 or 482.

590. SEMINAR: ADVANCED (1-2) Prerequisite: Psy. 500.

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591. SEMINAR ON TEACHING PSYCHOLOGY (1-3) Objectives and content of psychology; organization and presentation of material; teaching aids and techniques. Prerequisites: Psy. 407 or 501; 510 or 511.

599. THESIS (1-15 per semester)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. HONORS COURSE IN PSYCHOLOGY (2-6)
407. INTERMEDIATE EXPERIMENTAL PSYCHOLOGY (3) Professor Lepley
411, 411X. PSYCHOLOGY OF THE PRESCHOOL CHILD (3)
Professors van Ormer and Thevaos
412, 412X. ABNORMAL PSYCHOLOGY (3) Professor DeCamp
414, 414X. INTERMEDIATE EDUCATIONAL PSYCHOLOGY (2-3)
415, 415X. INTERMEDIATE STATISTICS IN PSYCHOLOGY AND EDUCATION (3)
Professor Kurtz
417. SOCIAL PSYCHOLOGY (2-3) Professor Carpenter
418. MEASUREMENT OF PERSONALITY (2-3) Professor Bernreuter
419. GUIDANCE AND EDUCATION IN SEXUAL AND MARITAL ADJUSTMENT (3)
Professor Adams
420. APPLIED SOCIAL PSYCHOLOGY (3) Professors Carpenter and Kinsley Smith
422. PSYCHOLOGICAL METHODS OF MEASURING THE REACTIONS OF THE PUBLIC (3)
Professor Guest
423. TEST CONSTRUCTION AND STANDARDIZATION (2-3) Professor Kurtz
424, 424X. PSYCHOLOGICAL TECHNIQUES IN PUBLIC PERSONNEL ADMINISTRATION (3)
Professor Adams
425, 425X. PSYCHOLOGY OF THE ELEMENTARY SCHOOL CHILD (2-3)
Professor van Ormer
426, 426X. ADOLESCENCE (2-3) Professors van Ormer and Thevaos
427. PSYCHOLOGICAL PRINCIPLES IN ADVERTISING (3) Professor Guest
428. OPINION RESEARCH LABORATORY (3) Professor Guest
429. PSYCHOLOGY OF COMMUNICATION (3)
431, 431X. INDUSTRIAL PSYCHOLOGY (3) Professor Kinsley Smith
437, 437X. PSYCHOLOGY OF ADJUSTMENT (3)
438. THEORY OF PERSONALITY (3) Professor Grosslight
440. PSYCHOLOGY PROJECTS (1-6)
445 (Ch.Fm. 445). DEVELOPMENT THROUGHOUT ADULTHOOD (3)
471, 471X. MEASUREMENT OF INTELLIGENCE (2) Professor Bernreuter
472. SPECIAL ABILITY TESTING (2)
482. INTRODUCTION TO CLINICAL PSYCHOLOGY (3) Professor Snyder
495S. FAMILY HEALTH AND HUMAN RELATIONS (3-9)

PUBLIC UTILITIES

PROFESSOR ARTHUR H. WAYNICK, B.S., M.S., Sc.D.
Head of the Department of Electrical Engineering

521. PUBLIC UTILITIES (3) Problems of current interest in the public utility field, principally those utilities involving use of principles of electrical engineering.

Professor Powell

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

421. ELECTRIC UTILITIES (3)

Professor Powell

RECREATION

Consult PROFESSOR FRED M. COOMBS, M.A.

530. CAMP ADMINISTRATION (3) Camp site development; staff selection, training, and supervision; development of objectives and program planning; values inherent in outdoor and camping education. Prerequisite: Recr. 430.

Professor Coombs

533. RECREATION STUDIES, SURVEYS, AND APPRAISALS (3) Types, purposes, and methods of conducting recreation studies and surveys; procedures in appraisal of community recreation. Prerequisite: Ph.Ed. 530.

Professor Coombs

560. ADMINISTRATIVE PROBLEMS OF RECREATION (3) Administrative problems in park and recreation departments; departmental organization, finance, personnel, facilities, program, and public relations. Prerequisite: Recr. 465.

Professor Coombs

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

430. CAMP COUNSELING (3)

Professor Coombs

432. RECREATION IN INDUSTRY (3)

Professor Coombs

434. RECREATION AREAS AND FACILITIES (3)

Professor Coombs

456. SOCIAL RECREATION (3)

Professor White

461, 461X. PROGRAMS OF COMMUNITY RECREATION (1 per unit)

Professor Coombs

Unit A. Programs of the Rural Community (1)

Unit B. Programs of the Urban Community (1)

Unit C. Programs of Large Municipalities (1)

462. RECREATION FOR THE HANDICAPPED (3)

Professor White

465, 465X. ADMINISTRATION OF RECREATION (3)

Professor Coombs

*RURAL SOCIOLOGY

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.

Head of the Department of Agricultural Economics and Rural Sociology

551. RURAL SOCIOLOGY SEMINAR (1-6) Prerequisite: 6 credits in rural sociology, sociology, or psychology.

552. THE STRUCTURE OF RURAL SOCIETY (3) Systematic review of research dealing with the structure of rural society; purpose, methodology, and contribution of each study treated. Prerequisites: R.Soc. 11, Soc. 1.

Professor John

* Credit in rural sociology will also be given for Agr.Ec. 505 and 525.

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553. RURAL SOCIAL PROCESSES (3) Continuation of R.Soc. 552. Functioning of rural society; research dealing with the subject reviewed and evaluated. Prerequisite: R.Soc. 552.
554. ADVANCED RURAL SOCIAL WELFARE (3) Analysis of welfare techniques and their application to rural situations. Prerequisites: R.Soc. 11; Psy. 2 or R.Soc. 459. *Professor Mather*
555. THE RURAL CHURCH (3) The rural church as a social institution; its relation to the community; the church in "problem" areas; effects of population trends on the program of the rural church; use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology. *Professor Mather*
556. THESIS IN RURAL SOCIOLOGY (6) Preparation of the required thesis for the degree of Master of Science in rural sociology while in residence at the College.
557. THE DEVELOPMENT OF THE RURAL COMMUNITY (3) Origin and evolution of the rural community under different geographic and cultural conditions. Prerequisites: R.Soc. 11 or Soc. 1; R.Soc. 452 or Soc. 415a. *Professor Mather*
559. ADVANCED RURAL SOCIAL PSYCHOLOGY (3) Application of social psychological principles to treatment of rural problems. Prerequisites: R.Soc. 11, Psy. 2. *Professor Green*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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|------------------------------------|-------------------------|
| 452. RURAL ORGANIZATION (3) | <i>Professor Brown</i> |
| 454. RURAL SOCIAL WELFARE (3) | <i>Professor Mather</i> |
| 456. RURAL STANDARDS OF LIVING (3) | <i>Professor Mather</i> |
| 459. RURAL SOCIAL PSYCHOLOGY (3) | <i>Professor Green</i> |

RUSSIAN

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.
Head of the Department of German

The following course may be taken for graduate credit under the restrictions in force:

401. STUDIES IN RUSSIAN LITERATURE (3-6)

SOCIOLOGY

PROFESSOR SETH W. RUSSELL, M.A., Ph.D.
Head of the Department

503. SEMINAR IN SOCIAL PSYCHOLOGY (3-9) Investigation of theories, methods, and empirical data of social psychology, with particular reference to such problems as relations between personality and culture, social and personal disorganization, development of role behavior, and conception of the self. *Professor Coutu*

510. **FIELD WORK IN SOCIOLOGY** (1-3) Advanced research projects to be carried out in the field under supervision of the department and recognized social agencies.
512. **SEMINAR IN MODERN CRIMINOLOGY** (3) Critical analysis of research in criminology and penology. *Professor Clark*
513. **ADVANCED SOCIOLOGICAL RESEARCH METHODS AND TECHNIQUES** (3) Special problems in scientific method and research technique; designed to prepare the student for social inquiry on a professional level; embraces both quantitative and nonquantitative types of work. Prerequisites: Soc. 413, 3 credits in statistics. *Professor John*
515. **STRUCTURE AND FUNCTIONS OF THE COMMUNITY** (3) *Professor Bernard*
516. **SOCIOLOGICAL THEORY** (3) *Professor Green*
523. **ADVANCED RESEARCH IN POPULATION** (3) Supervised original research on some aspect of demographic phenomena and vital statistics; a genuine contribution to knowledge is expected of the student. *Professor Clark*
525. **SEMINAR IN SOCIOLOGY** (1-9) Research problems in theoretical and applied sociology.
530. **RESEARCH ON MARRIAGE AND THE FAMILY** (3) Training in methods and techniques of research in family relations. Under the guidance of the instructor, experimental, statistical, and comparative studies are carried out, individually or co-operatively. Prerequisites: graduate standing and 3 credits of previous work in this field. *Professor Bernard*
540. **THEORY AND METHOD IN ANTHROPOLOGY** (3) Theory and method used in culture-historical, sociological, and psychological interpretations. *Professor Mook*
545. **SEMINAR IN ANTHROPOLOGY** (1-9) Critical analysis of research in selected areas of regional ethnography and ethnological theory. Prerequisites: Soc. 45, 445. *Professor Mook*
561. **SEMINAR IN SOCIOLOGY OF RELIGION** (3) Prerequisites: Soc. 60 or 61; 415a or 418; 400 or 401. *Professor Russell*
572. **METHODS OF SAMPLING** (3) Application of sampling techniques to sociological research. Prerequisite: Soc. 471. *Professor Clark*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. **SOCIOLOGICAL THEORY** (3) *Professor Blizzard*
401. **SOCIAL INSTITUTIONS** (3) *Professor Green*
- 403a, 403b. **ADVANCED SOCIAL PSYCHOLOGY** (3 each) *Professor Coutu*
- 405S. **SOCIAL PROBLEMS** (3)
408. **SOCIAL ECOLOGY** (3) *Professor Blizzard*
413. **METHODS AND TECHNIQUES OF SOCIAL RESEARCH** (1-6) *Professor Bernard*
- 415a. **COMMUNITY INSTITUTIONS** (3) *Professor Bernard*
418. **THE DEVELOPMENT OF SOCIAL THOUGHT** (3)
423. **POPULATION RESEARCH** (3) *Professor Clark*
424. **SOCIAL CHANGE** (3) *Professor Abramson*

SOCIOLOGY

- | | |
|---|--------------------|
| 425. CONTEMPORARY SOCIOLOGICAL THEORY (3) | Professor Green |
| 426. INTRODUCTION TO PUBLIC WELFARE (3) | Professor Mather |
| 427S. FAMILY CASE WORK (6) | |
| 429. SOCIAL STRATIFICATION (3) | |
| 431. COMMUNICATION AND MASS SOCIETY (3) | Professor Abramson |
| 441. FOLK SOCIETY (3) | Professor Mook |
| 442. ANTHROPOLOGY OF THE NEW WORLD (3) | Professor Mook |
| 443. ANTHROPOLOGY OF THE OLD WORLD (3) | Professor Mook |
| 445. PRIMITIVE SOCIETY (3) | Professor Mook |
| 461. SOCIOLOGY OF RELIGION (3) | Professor Russell |
| 470. USE OF STATISTICS IN SOCIOLOGY (3) | Professor Clark |
| 471. ADVANCED SOCIOLOGICAL STATISTICS (3) | Professor Clark |
| 495S. FAMILY HEALTH AND HUMAN RELATIONS (3) | |
| 499X. FOREIGN STUDY IN SOCIOLOGY (2-6) | |

SPANISH

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.
Acting Head of the Department of Romance Languages

- *1G. ELEMENTARY SPANISH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.
- 544. NEOCLASSICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Neoclassic movement in Italy, France, Spain, and Portugal.
- 545. ROMANTICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Romantic movement in Italy, France, Spain, and Portugal.
- 546. MEDIEVAL ROMANCE LITERATURES (3) Nature and development of medieval literature and thought, with particular reference to Italy, France, Spain and Portugal.
- 547. REALISM, WITH PARTICULAR REFERENCE TO ROMANCE LITERATURE (3)
- 548. 20TH CENTURY ROMANCE LITERATURE AS A POLITICAL FORCE (3)
- 551. ROMANCE PHILOLOGY (3) Historical development of the Romance languages.
- 552. OLD SPANISH READINGS (3) Familiarizes the student with Old Spanish texts.
- 561-562. SPANISH DRAMA PREVIOUS TO LOPE DE VEGA (3 each) Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed.
- 565. LOPE DE VEGA (3)
- 566. LOPE DE VEGA'S FOLLOWERS (3)
- 567-568. CERVANTES AND HIS WORKS (3 each)
- 571. SEMINAR IN SPANISH LITERATURE (3-12) Lectures on methods of research.

* No graduate credit is given for this course.

Students will pursue common and individual investigations in fields selected after consultation with the instructor.

572. SEMINAR IN SPANISH LITERATURE (3) Continuation of Sp. 571.
 574. METHODS AND BIBLIOGRAPHY IN ROMANCE LANGUAGES AND LITERATURES (1-2)
 599. DISSERTATION (1-15)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. THE GOLDEN AGE (3)
 402. DRAMA OF THE GOLDEN AGE (3)
 403. DON QUIXOTE (3)
 404. OLD SPANISH LANGUAGE AND LITERATURE (3)
 405. SPANISH DRAMA OF THE 19TH CENTURY (3)
 406. CONTEMPORARY SPANISH DRAMA (3)
 407. THE SPANISH NOVEL OF THE 19TH CENTURY (3)
 408. THE CONTEMPORARY SPANISH NOVEL (3)
 409, 409X. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)
 410. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)
 411. MEXICO: ITS LANGUAGE AND LITERATURE (3)
 412. ARGENTINA: ITS LANGUAGE AND LITERATURE (3)
 415. MODERN SPANISH LYRIC POETRY (3)
 417. SPANISH LITERATURE IN THE ROMANTIC PERIOD (3)
 421. THE TEACHING OF ROMANCE LANGUAGES (3)
 471. PROBLEMS IN SPANISH LITERATURE (3-6)
 490. ADVANCED COMPOSITION AND CONVERSATION (3)
 496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

SPEECH

PROFESSOR ROBERT T. OLIVER, M.A., Ph.D., LL.D.

Head of the Department

500. SEMINAR IN AMERICAN ORATORY (2-4) History of American oratory, with application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Spch. 200. *Professor Joseph O'Brien*
 505. HISTORICAL DEVELOPMENT OF SPEECH THEORY (2-4) Survey of ancient, medieval, and modern theories of public address in relation to currently accepted speech theories. *Professor DeBoer*
 508. SEMINAR IN BRITISH ORATORY (2-4) History of British oratory; application of critical standards to the work of selected orators. *Professor Fife*
 510. SEMINAR IN METHODS OF TEACHING SPEECH (2-4) Curriculum construction, media, and methods in high school and college. Prerequisite: 6 credits in speech including Spch. 200. *Professor Joseph O'Brien*
 520. SEMINAR IN SPEECH SCIENCE (2-4) Seminar in physical and physiological bases of speech and voice; introduction to laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology.

SPEECH

540. SEMINAR IN THE PROBLEMS OF RADIO (3) Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 credits in speech including Spch. 200, 300; 425 or 435.

Professor Nelson

550. SEMINAR IN ORAL PERSUASION (2-4) Theory and devices of persuasion; analysis of persuasive discourse. Prerequisite: 6 credits in speech including Spch. 200.

555. SPEECH COMMUNICATION: PROBLEMS AND PRINCIPLES (2-4) Prevalent theories of speech influence.

Professor Oliver

560. PUBLIC ADDRESS (2-4) Discussion and criticism of speech outline, manuscript, content, composition, and delivery. Prerequisite: 6 credits in speech including Spch. 200.

Professor Schug

575. RESEARCH PROBLEMS IN SPEECH (1-12) Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. TEACHING OF SPEECH (3)

Professor Schug

401. PROBLEMS, METHODS, AND AREAS IN SPEECH (1)

Professor Carter

405a,b,cS. PRACTICAL PROBLEMS IN PUBLIC AND PRIVATE SPEECH (1-3)

410. ENGLISH PHONETICS AND PRONUNCIATION (3)

Professor Joseph O'Brien

411a,b,cS. SPEECH SCIENCE AND SPEECH ARTS (1-3)

412. SPEECH COMPOSITION (3)

Professor DeBoer

415. EXPERIMENTAL AND APPLIED PHONETICS (3)

416. METHODS OF COACHING DEBATE (3)

Professor Harold O'Brien

425. ADVANCED PRINCIPLES OF RADIO SPEECH (3)

Professor Nelson

431. ANATOMY AND PHYSIOLOGY OF THE EAR AND VOCAL MECHANISMS (3)

Professor Siegenthaler

435. RADIO ORGANIZATION (3)

Professor Nelson

437. PRINCIPLES OF TELEVISION SPEECH (3)

Professor Nelson

445. SPEECH AS A MEDIUM OF INTERNATIONAL RELATIONS (3)

Professor Oliver

450. DISCUSSION TECHNIQUES (3)

Professor Joseph O'Brien

SPEECH EDUCATION

Consult PROFESSOR EUGENE T. McDONALD, M.Ed., D.Ed.

525. SEMINAR IN CLINICAL SPEECH PATHOLOGY (2-6) Prerequisites: Sph.Ed. 436, 442.

Unit A. Cleft Palate

Unit B. Cerebral Palsy

Unit C. Aphasia

530. SEMINAR IN AUDIOLOGY (2-4) Review of theories of hearing, and review of related physiological and psychological researches. Prerequisite: Sph.Ed. 434.

537. **ADVANCED CLINICAL PRACTICE IN SPEECH CORRECTION** (1-9) Prerequisites: Sph.Ed. 437, 442.

Unit A. Diagnostic Procedures (1-3)

Unit B. Treatment Procedures (1-6)

540. **ARTICULATION DISABILITIES** (3) Speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisites: Sph.Ed. 437, 442.

541. **THE VOICE AND ITS DISORDERS** (3) Physical, physiological, and psychological bases of voice production; causes, nature, and symptoms of its disorders; current clinical methods in voice improvement. Prerequisites: Sph.Ed. 437, 442.

542. **STUTTERING AND ALLIED DISORDERS** (3) Modern theories of causes and disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisites: Sph.Ed. 437, 442.

543. **DIAGNOSTIC PROCEDURES IN CLINICAL SPEECH** (3) Clinical instrumentation; case history taking; examination procedures and materials used in diagnosing speech disabilities; interpretation of findings; report preparation. Prerequisites: Sph.Ed. 437, 442.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

430. **HEARING PROBLEMS AND THE TESTING OF HEARING** (3)

434. **AUDIOMETRY AND HEARING AIDS** (3)

435. **CLINICAL PRACTICE WITH THE HEARING HANDICAPPED** (1-6)

436. **INTRODUCTION TO SPEECH CORRECTION** (3)

437. **CLINICAL PRACTICE IN SPEECH CORRECTION** (1-3)

439X. **FUNDAMENTALS OF SPEECH EDUCATION** (3)

439aX. **METHODS IN SPEECH EDUCATION** (3)

440, 440X. **SPEECH EDUCATION FOR THE CLASSROOM TEACHER** (2-3)

441S. **CURRENT PROBLEMS IN SPEECH AND HEARING** (1-6)

442. **SPEECH PATHOLOGY** (3)

443. **METHODS IN AUDITORY TRAINING AND SPEECH READING** (3)

445. **THE PUBLIC SCHOOL SPEECH CORRECTION PROGRAM** (3)

ZOOLOGY

PROFESSOR PENNOYER F. ENGLISH, M.S., Ph.D.

Acting Head of the Department of Zoology and Entomology

508. **ADVANCED PARASITOLOGY** (3) Advanced work on the structure, life cycle, and control of parasites. Prerequisites: Ent. 2, Zool. 432. *Professor Zeliff*

509. **TECHNIQUES IN WILDLIFE MANAGEMENT** (3) Preparing study mounts, census making, management area mapping, methods of collecting data, and determining food habits from stomach contents. Prerequisite: Zool. 546. *Professor English*

512. **SEMINAR** (1) Review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology. *Professor English*

ZOOLOGY

513. RESEARCH (1-15 per semester) Prosecution of an assigned problem under the guidance of an instructor. Prerequisites: Zool. 410, 432, 437, 440 or 546.

532S. ANIMAL PARASITES (3) Structure, life cycle, and control. Prerequisite: Zool. 432.

541. COMPARATIVE PHYSIOLOGY (3) Dynamics of vital processes as shown in members of the animal kingdom. Prerequisites: Zool. 25, 26; A.B.Ch. 1; A.B.Ch. 425 or Zool. 437. *Professor Frings*

546. THE THEORY OF GAME MANAGEMENT (4) Fundamental principles underlying management of wild game birds and mammals; co-ordination of such management with various land uses; planning preserves and other land areas. Prerequisites: Zool. 408, 420. *Professor English*

547S. WILDLIFE MANAGEMENT (3) Basic principles concerned with management of game birds and game mammals. Prerequisites: Zool. 25, 26, 420. *Professor English*

551. FISHERIES MANAGEMENT (3) Basic principles underlying management of inland waters for fish production. Prerequisite: Zool. 450.

581. ADVANCED INVERTEBRATE ZOOLOGY (3) Morphology, physiology, taxonomy, and life histories of invertebrate animals. *Professor Frings*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

408. MAMMALOGY (4) *Professor English*

410. GENERAL LIMNOLOGY (3)

415. THE LITERATURE OF ZOOLOGY (1) *Professor Frings*

416. THE METHODS OF RESEARCH IN ZOOLOGY (2)

417. INVERTEBRATE FAUNISTICS (4) *Professor Frings*

418S. FIELD ORNITHOLOGY (3) *Professor Wood*

419S. GENERAL ANIMAL ECOLOGY (3) *Professor Blackburn*

420. GAME BIRDS (3) *Professor English*

432. HUMAN PARASITOLOGY (3) *Professor Zelif*

436. PROTOZOOLOGY (3) *Professor Zelif*

437. HISTOLOGY (4) *Professor Newman*

440. EMBRYOLOGY (4) *Professor Newman*

444. ZOOLOGICAL PROBLEMS (1-6)

445S. THE IDENTIFICATION OF INSECTS (3) *Professor Blackburn*

448. ORNITHOLOGY (3) *Professor Wood*

450. ICHTHYOLOGY (4)





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THE PENNSYLVANIA STATE
UNIVERSITY BULLETIN

Graduate School Announcement
1954 - 1955

1855 • PENN STATE CENTENNIAL • 1955

1954-1955

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THE PENNSYLVANIA STATE
UNIVERSITY BULLETIN

GRADUATE SCHOOL

ANNOUNCEMENT

1954 - 1955



1855 • PENN STATE CENTENNIAL • 1955

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CALENDAR

SPRING SEMESTER 1954

FEBRUARY 1954

- 3-6 Wednesday to Saturday—Spring Semester Registration and Orientation
- 8 Monday—Spring Semester Classes Begin 8 a.m.

APRIL

- 14 Wednesday—Spring Recess Begins 11:50 a.m.
- 21 Wednesday—Spring Recess Ends 1:10 p.m.

MAY

- 29 Saturday—Spring Semester Classes End 11:50 a.m.
- 29 Saturday—Spring Semester Examinations Begin 1:30 p.m.

JUNE

- 6 Sunday—Baccalaureate Day, Class Day
- 7 Monday—Spring Semester Ends 5 p.m.
- 7 Monday—Commencement Day

SUMMER SESSIONS 1954

JUNE 1954

- 8 Tuesday—Registration for Inter-Session in a.m.
- 8 Tuesday—Inter-Session Classes Begin 1:20 p.m.
- 25 Friday—Inter-Session Ends 5:50 p.m.
- 28 Monday—Registration for Main Summer Session
- 29 Tuesday—Main Summer Session Classes Begin 8 a.m.

JULY

- 5 Monday—Independence Day Recess

AUGUST

- 6 Friday—Main Summer Session Ends 5:50 p.m.
- 7 Saturday—Main Summer Session Graduation Exercises
- 9 Monday—Registration for Post-Session in a.m.
- 9 Monday—Post-Session Classes Begin 1:20 p.m.
- 27 Friday—Post-Session Ends 5:50 p.m.

CALENDAR

FALL SEMESTER 1954

SEPTEMBER 1954

- 12 Sunday—Orientation Week Begins
- 15-18 Wednesday to Saturday—Fall Semester Registration
- 20 Monday—Fall Semester Classes Begin 8 a.m.

NOVEMBER

- 24 Wednesday—Thanksgiving Recess Begins 11:50 a.m.
- 29 Monday—Thanksgiving Recess Ends 8 a.m.

DECEMBER

- 18 Saturday—Christmas Recess Begins 11:50 a.m.

JANUARY 1955

- 3 Monday—Christmas Recess Ends 8 a.m.
- 19 Wednesday—Fall Semester Classes End 5 p.m.
- 20 Thursday—Fall Semester Examinations Begin 8 a.m.
- 28 Friday—Fall Semester Ends 5:30 p.m.
- 31 Monday—Fall Semester Graduation Exercises

SPRING SEMESTER 1955

FEBRUARY 1955

- 2-5 Wednesday to Saturday—Spring Semester Registration and Orientation
- 7 Monday—Spring Semester Classes Begin 8 a.m.

APRIL

- 6 Wednesday—Spring Recess Begins 11:50 a.m.
- 13 Wednesday—Spring Recess Ends 1:10 p.m.

MAY

- 28 Saturday—Spring Semester Classes End 11:50 a.m.
- 28 Saturday—Spring Semester Examinations Begin 1:20 p.m.
- 30 Monday—Memorial Day Recess

JUNE

- 8 Wednesday—Spring Semester Ends 12:30 p.m.
- 10 Friday—Baccalaureate Day
- 11 Saturday—Commencement Day

UNIVERSITY ADMINISTRATIVE OFFICERS

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* Ex officio.

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R. E. TSCHAN, M.A.	<i>College Examiner</i>

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Assistant Professor of Fuel Technology

WALTER H. WALTERS, Ph.M., M.F.A., Ph.D.

Assistant Professor of Dramatics

THOMAS WARTIK, Ph.D.

Assistant Professor of Chemistry

GEORGE HARRISON WATROUS, Jr., M.S., Ph.D.

Assistant Professor of Dairy Husbandry

ALFRED FREDERICK WOELFEL, M.S.

Assistant Professor of Electrical Engineering

HAROLD D. WRIGHT, M.A., Ph.D.

Assistant Professor of Mineralogy

VICTOR F. ZACKAY, M.S., Ph.D.

Assistant Professor of Metallurgy

C. COURSON ZELIFF, M.S., Ph.D.

Assistant Professor of Zoology

LEONARD N. ZIMMERMAN, M.S., Ph.D.

Assistant Professor of Bacteriology

HARRY DAVID ZOOK, M.S., Ph.D.

Assistant Professor of Chemistry

INSTRUCTORS

CHRISTINE W. AYOUB, M.A., Ph.D.

Instructor in Mathematics (part-time)

WILLIAM E. COBB, M.Ed., D.Ed.

Instructor in Education

RESEARCH ASSOCIATE

ROBERT M. WITUCKI, M.S., Ph.D.

Research Associate in Ceramics

THE GRADUATE SCHOOL

GRADUATE WORK at The Pennsylvania State University was first offered in 1862 when two graduate students were in residence. It was given more formal recognition in 1864 by the establishment of a "Course for Graduates" designed for students who, after receiving the degree of Bachelor of Scientific Agriculture, wished to do advanced work leading to the degree of Master of Scientific Agriculture. For some time there were few graduate students, and graduate instruction was relatively unorganized. Later a committee of the University Senate was given the responsibility of establishing standards and regulations governing graduate work and the granting of advanced degrees. The Graduate School was organized in 1922. Until this time only master's degrees and certain technical degrees had been conferred. In 1924, upon recommendation of the Graduate School, the Board of Trustees authorized the granting of the degree of Doctor of Philosophy. Still later other degrees were approved.

The faculty of the Graduate School consists of the President and certain other general administrative officers of the University, the Deans, the University Examiner, the Librarian, the heads of departments, and those members of the instructional staff who have been authorized by the proper agencies of the Graduate School to offer graduate courses and supervise research leading to theses and dissertations. It controls all academic matters pertaining to the Graduate School, subject to review by the University Senate.

The graduate faculty numbers approximately 550 members. Graduate student enrollment in 1952-53 was about 1400 per semester. During the summer sessions the graduate enrollment increased to approximately 2000. The number of advanced degrees conferred in 1952-53 was 713, of which 131 were doctor's degrees.

Applicants for admission to the Graduate School should understand that graduate work is not an extension of undergraduate work. It operates at a definitely higher level, demands scholarship of a high order, and emphasizes research and creativity. It involves a minimum of formal requirements and regulations, and a maximum of student initiative and responsibility.

Students are expected to assume full responsibility for knowing the regulations and pertinent procedures of the Graduate School (as set forth in the *Graduate School Announcement* and in the *Manual for Graduate Students*) and for meeting the standards and requirements expressed by these regulations. The *Manual*, which is available to students after they have been admitted, sets forth in more detail the general regulations outlined in the *Announcement* and furnishes other information about the Graduate School which is useful to graduate students. Students should secure a copy of this manual from the Dean's Office as soon as possible after admission.

PROCEDURES AND REGULATIONS

ADMISSION—A student does not become a graduate student merely by enrolling for advanced courses after having received a baccalaureate degree. Formal admission to the Graduate School is required. Credits earned before admission cannot be applied to meet degree requirements at a later date even though admission may have been granted in the meantime.

For admission to the Graduate School an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit

conditions substantially equivalent to those required by The Pennsylvania State University. He must have maintained during his junior and senior years a minimum grade point average equivalent to 1.5 on The Pennsylvania State University grading scale. Finally, he must ordinarily have completed in a satisfactory manner a certain minimum of course work in designated areas, the specific courses and amount of required work depending upon the field of advanced study which the student proposes to enter.

The minimum average of 1.5 during the last two undergraduate years is a general requirement of the Graduate School. Individual departments may require a higher average for admission to advanced study in their fields. Prospective students are encouraged to write directly to the head of any department concerning graduate work in that specific field.

A student applying for admission after having attended another graduate school where a substantial amount of credit has been earned, or a student whose career subsequent to graduation has been characterized by unusual attainments in fields having a bearing on his graduate qualifications, will be rated by a combination of the records submitted.

Admission to the Graduate School is granted by the Dean of Admissions after approval of the application for admission by the department in which the student plans to do his major work. Blanks to be used in making formal application for admission can be obtained from the Dean of Admissions. With his application each student should present the names of two persons to whom departments may write, and who are well qualified to evaluate his abilities for graduate work in the field of his choice.

An applicant for admission should provide complete credentials, in duplicate, sent directly from other institutions to the Dean of Admissions well in advance of the date when the student expects to enroll. If the applicant has attended more than one institution, two official transcripts of the work covered at each institution are required. This applies to the complete academic record, both undergraduate and graduate.

If credentials are not sent in advance or are not available at the time of registration, this does not necessarily mean that the application for admission will be refused. However, it does mean that the applicant will be admitted only on a provisional basis pending receipt of his official credentials. The provisional admission will be subject to cancellation if the credentials, on their arrival, do not meet all the requirements for admission to the Graduate School. Also, certification of any scheduled credits while the applicant is holding provisional admission will be withheld until receipt of his official credentials makes possible the applicant's permanent admission to the Graduate School.

Formal readmission is not required year by year, nor after one or more semesters of absence from the campus. However, a student who has earned a master's degree should not register for further work until his academic record and personal qualifications have been reviewed critically by the department of his major interest and he has been encouraged to become a candidate for the doctorate or has the department's approval for proceeding for a short time as a general graduate student.

The President of the University, on recommendation of the Dean of the Graduate School, will welcome doctors of philosophy of The Pennsylvania State University, as well as those of other accredited colleges and universities, as guests of the University, with the privilege of attending seminars and courses and of carrying on research in laboratories and libraries. There will be no charge except for laboratory expenses. Arrangements should be made in advance with the Dean of the Graduate School.

PROCEDURES AND REGULATIONS

CLASSIFICATION—At the time of admission all students are classified either as regular graduate students or as general graduate students. Regardless of classification, all students, upon admission to the Graduate School, must register through the Graduate Dean's office for all work taken, whether or not that work is to be credited toward the requirements for a degree.

Regular Graduate Students—This group includes those persons who plan to become candidates for degrees at The Pennsylvania State University and who have been formally admitted by the Dean of Admissions for advanced study in a particular department. The program of study is developed under the guidance of the department head or his representative. Graduate students who plan to be candidates for advanced degrees should enroll as regular graduate students.

It should be emphasized that a student is not a regular graduate student unless he has been officially admitted to that status. Regular attendance in the Graduate School or personal plans for future degree candidacy do not in themselves grant the status or privileges of a regular graduate student.

Regular graduate students who have passed candidacy evaluations are classified as doctoral candidates and may register for doctoral dissertation credit.

General Graduate Students—Applicants who meet all requirements for admission to the Graduate School, but who do not wish to work for an advanced degree at this institution, may arrange for a program of work as general graduate students. This classification includes those who plan to transfer credits to another institution and those who plan to follow a special program of study for the fulfillment of requirements other than those for advanced degrees. The program of study is developed under the guidance of an adviser appointed by the Dean of the Graduate School.

The status and standing of a general graduate student will be reviewed by the Dean each time he reregisters. He may not remain a general graduate student longer than one semester (or summer sessions totaling 12 weeks) except with the permission of the Dean, and for definite and good reasons.

When a general graduate student wishes to become a regular graduate student, i.e., to work for an advanced degree at this institution, he should make application for change of status. His undergraduate record will then be re-evaluated to determine to what extent he is prepared to undertake graduate work for a degree in the major field of his choice. He should understand that he may thereafter apply toward degree requirements only those credits earned as a general graduate student which fit logically into an integrated degree program. There is no upper limit on the number of credits that may be so applied; neither is there any assurance that any such credits may be applicable.

Special and Unclassified Students—Special and unclassified students are not graduate students, inasmuch as they have not been admitted to the Graduate School. Consequently they are not permitted to register for graduate courses (500 series). Special or unclassified students who are later admitted to the Graduate School may not then count toward degree requirements any credits whatsoever that have been earned by them while in the special student status.

REGISTRATION—Students are required to register for each semester and each summer session in which they propose to do either course work or research, either on or off the campus.

For each registration the student, in consultation with his adviser, prepares a schedule of courses and research designed to fit his individual needs, which is then

submitted to the Dean of the Graduate School for his approval. The registration process is then completed in the manner specified for all students at the University.

Under certain conditions credit may be earned by work done off the campus. Students contemplating such work should inquire of the Dean of the Graduate School about the plans and conditions. Such work must be scheduled *in advance* in the regular manner.

Registration dates are given in the University Calendar and a penalty fee is assessed for failure to register on the appointed days. In any case, registration must be completed within the first two weeks of a semester or within the first one-sixth of any summer session. All changes of schedule must also be completed within this period, with the exception that a student may drop a course at any time within the first four weeks of a semester.

ACADEMIC LOAD—A full-time student is one who devotes "all" his time to studies and/or research, and very little, if any, time to work for financial compensation. The normal maximum full-time credit load is 15 credits per semester, or 1 credit per week in shorter terms such as summer sessions. Larger loads may be scheduled very rarely and only with the approval of the Dean of the Graduate School. Ordinarily students employed for more than a few hours per week may not register for 15 credits per semester, or 1 credit per week.

The University takes the position that the facilities of the Graduate School should be made available only to students who can profit from their graduate school experience to a maximum extent. Therefore the Graduate School reserves the right to deny admission or registration to part-time students who (a) propose schedules of few credits which seem to reflect little real interest in graduate work or would not seem to require serious effort, or (b) wish to carry overloads of such proportions as to handicap them seriously in achieving maximum quality in their graduate work.

Part-time students who are graduate assistants or employees of the University are governed by the following load schedules:

SERVICE LOAD		ACADEMIC LOAD
<i>Fraction of Full Load</i>	<i>Hours per Week</i>	<i>Credits</i>
1/4	10	10 - 13
1/2	20	8 - 10
3/4	30	6 - 8
4/4	40	0 - 6

The considerations leading to the establishment of this "protective" schedule of permitted loads for assistants and employees apply equally to part-time students employed off-campus.

AUDITING OF COURSES—Students who have demonstrated their ability to do superior work while carrying normal graduate programs (which are determined by their status as full-time students, or as part-time students employed on the campus or elsewhere) may, with the approval of the Dean, register for "audits" in addition to their normal credit loads. To secure such approval the student should present to the Dean written evidence that the instructor of the "audit" course will accept him as auditor, and that his adviser and the head of the department employing him (if he be employed) approve of the extra load.

GRADUATION—It is the responsibility of the student to fill out a diploma card

ACADEMIC DEGREES

at the beginning of the semester or session at the end of which he expects to receive an advanced degree.

All degrees conferred are tentative until final grade reports have been received even though the student's name may have appeared in the printed commencement program.

Attendance at commencement exercises is an obligation on the part of those receiving advanced degrees. A request to receive the degree *in absentia* may be presented to the Dean of the Graduate School, but only under extraordinary circumstances will it be granted.

Degrees are normally granted at the end of each semester and at the end of the Main Summer Session. Students who complete their work at the end of Post-Session may, if an imperative need exists, receive their diplomas at the end of the summer provided they make special application at the time of Post-Session registration.

ACADEMIC DEGREES

MASTER OF ARTS AND MASTER OF SCIENCE

These two degrees have similar requirements, the Master of Arts being conferred upon students in the liberal arts and the Master of Science upon those in science and technology.

ADMISSION—Adequate undergraduate preparation is required in the field in which the applicant expects to pursue advanced work. The specific courses and the total number of undergraduate credits required in various areas will be determined by the choice of field and can be ascertained from the Dean of Admissions. An applicant who meets the minimum grade point average but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A program for the master's degree requires a minimum of 30 credits and consists of a major and either a minor or a group of general studies. A minor consists of not less than 6 credits of integrated or articulated work in one field related to but different from that of the major. A general studies group consists of 6 credits in fields other than that designated as the major field considered by the major department to have significance and value for the candidate.

The program requires the equivalent of at least one academic year (two semesters), and may be met by full-time residence, part-time work, attendance in the summer sessions, or by any combination of these. Many students find that adequate programs leading to the master's degree involve considerably more than 30 credits and require more than one year's work. Ten credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State University may, under certain conditions, be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

At least 12 credits earned in course work and a thesis equivalent to at least 6 credits must be devoted to the major subject. At least 18 credits in graduate courses (500 series) and thesis research combined must be offered toward the fulfillment of minimum requirements for the degree. A student's program must be approved by his adviser and the Dean.

In addition to the above general requirements, major departments may set up specific course and subject-matter requirements for students working in their area.

The mere completion of a stated amount of work does not entitle a student to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS—Under the direction of the department in which the student's major subject is taken, he must prepare a thesis upon a suitable topic-related to that subject. Under certain conditions a student may be permitted to complete the thesis *in absentia*. To obtain such permission he must make satisfactory arrangements in advance both with the major department and with the Dean.

For instructions concerning the form and the filing of typewritten copies of the thesis, see the *Manual for Graduate Students*.

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced by (1) the satisfactory completion of a prescribed period of study and investigation, (2) the preparation of a dissertation involving independent research, and (3) successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State University in regular semesters. A minimum of three academic years of full-time graduate study and research, or their equivalent, is required for the attainment of a doctor's degree. The equivalent of two academic years may be secured by residence at another institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and dissertation requirements within the period of one academic year on this campus.

Students devoting only a portion of their time to their program will be credited on their residence requirements in proportion to the time actually spent in graduate study and research.

For regulations and procedures concerning off-campus research, see the *Manual for Graduate Students*.

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The program shall consist of such a combination of courses and research as is approved by the doctoral committee for each individual student, and includes a major and either a minor or a group of general studies. Approximately two thirds of the total time is to be devoted to the major field. A minor consists of not less than 15 credits, including those applied toward the master's degree, of integrated or articulated work in one field related to but different from that of the major. A general studies group consists of not less than 15 credits, including those applied toward the master's degree, in fields other than that designated as the major field considered by the major department to have significance and value for the candidate.

The first year of graduate study leading to the doctor's degree may be substantially the same as that provided for the master's degree and may lead to that degree, although that is not necessary.

DOCTOR OF PHILOSOPHY

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Philosophy must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of residence. A student transferring from another graduate school must take this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department. If the student passes the examination, and in the opinion of the graduate faculty of his major department is qualified to follow a doctoral program, he is admitted to candidacy.

After a student has been admitted to candidacy the Dean will appoint, upon recommendation of the head of the major department, his doctoral committee which will thereafter guide him in candidacy.

For the Doctor of Philosophy degree, candidates are required to have a reading knowledge of at least two foreign languages. German and French are the languages most often needed. Other languages may be presented instead of these if their choice is determined by scholarly and professional reasons. The choice of a language must be approved by the major department. If a language other than English, French, German, Italian, Spanish, or Russian is presented, it must be approved also by the Dean of the Graduate School. A student may not present his mother tongue as one of the two languages required in candidacy. Candidates may present certification of having passed equivalent language examinations in other institutions in lieu of repeating the examinations. For further details, see the *Manual for Graduate Students*.

When a doctoral candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether he has adequate mastery of the subject matter to entitle him to proceed to the completion of a dissertation. The candidate must have satisfied the language requirements before taking this examination.

Doctoral candidates who have satisfied all other requirements for the degree will be scheduled, on recommendation of the doctoral committee, to take a final examination. In no case may the final examination be scheduled less than three months after the comprehensive examination. The final examination is oral, open to the public, related in large part to the dissertation, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

DISSERTATION—The ability to do independent research must be proved by the preparation of a dissertation on some topic related to the major subject. It should represent a contribution on some worth-while problem presented in a scholarly manner. The contents and conclusions of the dissertation must be defended at the time of the final examination.

The general subject of the dissertation must be determined at the time of admission to candidacy for the degree, and the completed dissertation, typewritten in triplicate, must be filed in the office of the Dean of the Graduate School not later than one week prior to the commencement at which the candidate expects to receive the degree.

For regulations concerning the form and the filing of the dissertation, see the *Manual for Graduate Students*.

PROFESSIONAL DEGREES

MASTER OF EDUCATION

In order to provide programs of advanced work which would utilize more fully the professional training and background of those holding bachelor's degrees from teachers colleges and schools of education, two professional degrees in education were established.

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership in educational work, and ability to solve concrete problems in at least one special field of educational activity.

ADMISSION—Applicants are required to have had at least 27 undergraduate credits in the field of education, including practice teaching, except that under certain circumstances this rule may be waived for students working for the Doctor of Education degree with a major in higher education. Applicants wishing to major in subject-matter fields will be expected to have in addition an adequate undergraduate preparation in the field of specialization. The specific course requirements and the total number of undergraduate credits required in the various areas will be determined by the choice of field and can be ascertained from the Dean of Admissions. An applicant who meets the minimum grade point average for admission but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A minimum of 30 credits is required, of which 6 may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters) and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Ten credits earned in residence at another approved institution or in extension classes of The Pennsylvania State University may, under certain conditions, be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A minimum of 24 credits must be earned in graduate course work. The larger part of this work shall be in courses open only to graduate students, but the needs of the student shall be considered in arranging the best combination of courses (400 and 500 series) for the preparation of the candidate in his special field. The degree program must be approved by the student's adviser or advisory committee.

When the student chooses a group major, his study program will be approved by a standing committee (or its representatives), which committee will foster the student's interests and stand in the same relation to him as does a department in the case of a student with a specific major. Such standing committees have been appointed in the broad fields of biological science, physical science, and social studies.

If a thesis is included in the program, it must be done under the direction of a supervisor representing either a major department or a standing committee supervising group majors. An amount of time equivalent to six credits may be devoted to research and the preparation of the thesis. Under certain conditions this may be carried out in part *in absentia*, particularly when requirements are met by summer session attendance. For regulations concerning the form and filing of theses, see the *Manual for Graduate Students*.

DOCTOR OF EDUCATION

MAJOR AND MINOR FIELDS—If a student looks forward to a career as a teacher, he may specialize in a specific subject-matter field (such as English, mathematics, Latin, etc.), and that shall be regarded as the major field, and a majority of the work is to be taken there. In this case the student is required to have a minor consisting of not less than 6 credits in basic education (includes comparative education, educational measurements and statistics, educational psychology, history of education, and philosophy of education). If he can demonstrate by examination adequate background in basic education, he may choose a minor in any field of education.

If a student wishes to work in a broader field, a group major such as social studies, physical science, or biological science may be chosen. In this case at least 24 credits are to be devoted to the group, and 6 credits to a minor in basic education. It is expected that each student will choose one subject of the group as a field of primary interest, to which at least 12 credits are to be devoted.

If a student looks forward to a career as a guidance counselor or administrator, he may specialize in one of the fields of education and choose that as his major. In this case the student is required to have a minor consisting of not less than 6 credits in either a field outside of education or in basic education as defined above.

EXAMINATIONS—Candidates for the Master of Education degree must pass a final comprehensive examination. The examination will be designed to determine the ability of the candidate to apply the general as well as the special knowledge of his chosen field in practical situations.

Candidates majoring in education are required to take a departmental qualifying examination, comprehensive in scope, before completing the second half of their course requirements. This serves as a guide in outlining a program of study that will fit the individual needs of the student.

DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced (1) by the satisfactory completion of a prescribed period of study; (2) by the application of scientific principles in classroom teaching, in the supervision of instruction, or in administrative work; (3) by the preparation of a dissertation demonstrating ability to attack an educational problem with originality and independent thought; (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects; and (5) by recognized leadership in the profession of education.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State University. This requirement may be met by attendance at summer sessions, although there is no guarantee that it will be possible to do so in all cases. An equivalent of three years of graduate study is required as a minimum for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

The equivalent of two full years of work may be secured by residence at another institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and dissertation requirements within the period of one academic year on this campus. Credit for courses and

research work done elsewhere can be used to meet degree requirements only if appropriate to the candidate's proposed program of study as determined by his doctoral committee.

One third of the requirements (equivalent to a 30-credit year) for the degree may be met by research work pursued away from the campus in the school systems of the State, or in other approved centers, provided (1) the plan be approved by the candidate's doctoral committee, (2) reports on the projects be made as directed by this committee, (3) not more than 6 credits be earned in a semester, and (4) the arrangement be approved by the Dean.

Work done off the campus which is to be credited toward a doctor's degree must be scheduled *in advance*, following regular registration procedure.

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a period of residence, a satisfactory dissertation, the passing of comprehensive examinations, and possession of the qualities of professional leadership. A program shall consist of such a combination of courses and individual study and research as is approved by the doctoral committee for each candidate. The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement must be in the major field of study.

A candidate choosing a major outside the fields of education (such as chemistry, English, or history) shall have a minor consisting of not less than 15 credits, including those applied toward the master's degree, in psychology and basic education (includes comparative education, educational measurements and statistics, educational psychology, history of education, and philosophy of education).

A candidate choosing a major in one of the fields of education must also choose either a minor or a group of general studies with the approval of the major department. In this case a minor consists of not less than 15 credits, including those applied toward the master's degree, in one field outside the fields of education. An acceptable general studies group consists of not less than 15 credits, including those applied toward the master's degree, in fields outside the fields of education considered by the major department to have significance and value for the candidate. Every candidate must show through comprehensive examinations that he is familiar with current theories of education, that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject, that he is prepared to read understandingly and contribute to the technical professional literature in his field, and that he can criticize his own procedures in the light of historical trends and practices in this and other countries. Command of the tools for a thorough study of the problems of education is necessary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Education must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of residence. A student transferring from another graduate school must take

MASTER OF FORESTRY

this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department.

Three of the important factors taken into consideration in passing judgment upon admission to candidacy are:

1. Previous scholastic record at this institution and other institutions attended.
2. Achievement in qualifying examinations.
3. Estimates of the student's personal and professional qualifications by the graduate faculty of the major department.

After a student has been admitted to candidacy, the Dean, upon recommendation of the head of the major department, will appoint his doctoral committee which will thereafter guide him in candidacy.

When the candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether or not he is to be permitted to proceed to the completion of his dissertation. These examinations will be designed to test (1) the candidate's general scholastic preparation and professional background, and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

A candidate who has fulfilled all other requirements for the degree will, on recommendation of his doctoral committee, be permitted to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's doctoral committee and others appointed by the Dean of the Graduate School. In no case may the final examination be scheduled less than three months after the comprehensive examination. The final examination will be based largely upon the dissertation, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

For further details, see the *Manual for Graduate Students*.

DISSERTATION—Evidence of a high degree of scholarship and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written dissertation. The candidate must demonstrate capacity for independent thought as well as ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed dissertation must have the approval of the doctoral committee.

For instructions concerning the form and filing of the dissertation, see the *Manual for Graduate Students*.

MASTER OF FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for additional study in a student's particular field of interest rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

ADMISSION—An applicant for admission is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the Dean of Admissions. If there are deficiencies

at the time of admission, they must be removed early in the program. While making up deficiencies in prerequisite credits, the student must follow a program approved by his advisory committee. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School.

REQUIREMENTS—A minimum of 30 credits is required for the degree of Master of Forestry. These credits are to be taken in the best arrangement of courses in the 400 and 500 series suited to the needs of the individual student. Although not required, a maximum of 6 credits may be assigned to a thesis upon approval and recommendation of the head of the Department of Forestry. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A maximum of 10 credits earned in extension classes of The Pennsylvania State University or in resident classes of other approved institutions may, under certain conditions, be applied toward the degree provided they fit into the program of the student.

A student should choose one field of work for his major interest, with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with an advisory committee. Ordinarily this committee consists of the head of the Department of Forestry and the professors in charge of the major and minor fields.

TECHNICAL DEGREES

ADMISSION—A graduate of the College of Chemistry and Physics, of the College of Engineering and Architecture, or of the College of Mineral Industries of The Pennsylvania State University may be admitted to work for a technical degree, provided he submits evidence of having been engaged for a period of not less than three years in acceptable professional work in the field of engineering in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in engineering in a professorial rank in this institution, and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees. An applicant who is eligible for a technical degree is admitted to the Graduate School by the Dean of Admissions.

An applicant for a technical degree must file with the Dean of Admissions an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the admission fee of \$5.

Registration for these degrees is the same as for resident students. A candidate must be registered during two regular semesters.

DEGREES AND REQUIREMENTS—The technical degrees are as follows: Aeronautical Engineer, Architectural Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer, Fuels Engineer, Industrial Engineer, Ceramic Engineer, Mechanical Engineer, Engineer of Mines, Metallurgical Engineer, Petroleum Engineer, and Sanitary Engineer.

Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his applica-

GENERAL INFORMATION — FEES

tion for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate College concerned.

In order to be recommended for a technical degree, the candidate must prepare a thesis on a subject related to his profession. He must register in the manner specified in the foregoing section and pay the registration and graduation fees. He may be required to appear in person to defend his thesis.

THESIS—Immediately following registration the candidate must submit for approval an outline of his proposed thesis; and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

For regulations concerning the form and filing of the thesis, see the *Manual for Graduate Students*.

GENERAL INFORMATION

FEES—

REGULAR FEES, PAID EACH SEMESTER:

Students registered for 12 or more credits:

Residents of Pennsylvania	\$120.00
Nonresidents of Pennsylvania	245.00

Students registered for fewer than 12 credits:

Residents of Pennsylvania, per credit	11.00
Nonresidents of Pennsylvania, on-campus studies, per credit	21.00
Nonresidents of Pennsylvania, off-campus research, per credit	11.00

Graduate assistants, fellows, and scholars:

Health and welfare charge	18.00
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SPECIAL FEES, PAID AS OCCASION DEMANDS:

Applicable to all students, including graduate assistants, fellows, and scholars:

Admission to the Graduate School	5.00
Privilege of late registration or late payment	10.00
Change of schedule, each change	2.00
Publication of dissertation abstract	35.00
Transcript of record, each additional copy	1.00

With reference to fees, courses that are scheduled for audit are considered the same as though they were scheduled for credit.

Summer sessions students who register for graduate courses pay the regular fees for the summer sessions.

Whenever it shall appear from any of the data presented as part of the application for admission that the applicant is not domiciled in Pennsylvania, the Dean of Admissions, when admission is granted to that applicant, assumes that the one admitted is a non-Pennsylvanian and includes that admission as part of the estab-

lished out-of-State quota. A student so admitted is held liable for the out-of-State tuition fee.

If the one who is admitted believes that his circumstances do not justify his classification as a non-Pennsylvanian, he may petition the Dean of Admissions for reclassification.

Whenever such a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous domicile of the one admitted (or of his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding his admission, and, in addition, such other evidence as may appear pertinent to a complete review of his classification.

Any student who does not fulfill payment obligations promptly may be charged \$1 for each day of delinquency up to and including five days, or a maximum of \$10 if the delinquency exceeds five days. Students whose accounts are delinquent for more than 10 days are subject to suspension from the University.

GRADING SYSTEM—Grades are given to students solely on the basis of the instructor's judgment as to the student's scholarly attainment.

For graduate courses (500 series) one of three grades may be given:

H for Honors, indicating definitely superior attainment.

P for Pass, indicating acceptable but not superior attainment.

F for Fail, indicating failure to attain the minimum standards of work acceptable for credit in a degree program.

For research, thesis, or dissertation one of four grades may be given:

H for Honors, indicating definitely superior attainment.

P for Pass, indicating acceptable but not superior attainment.

F for Fail, indicating failure to spend an appreciable amount of time doing the scheduled work or failure to attain the minimum standards of work acceptable for credit in a degree program.

R for Research, indicating that the investigation is continuing and that the student has devoted an adequate amount of time to the work scheduled but that the supervisor does not want to give a quality grade (H, P, or F) at this point. When the project is completed an H, P, or F must be given and will be considered the quality grade for the entire research. Grades of R given while the research was in progress will remain on the student's record permanently.

For 400 series courses one of six grades may be given:

3—90 to 100 inclusive	0—60 to 69 inclusive
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2—80 to 89 inclusive	—1—45 to 59 inclusive
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1—70 to 79 inclusive	—2—0 to 44 inclusive
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Grades below 2 do not carry graduate credit.

HEALTH SERVICE—The University Health Service is available to graduate students who register for 12 or more credits or who hold appointments as fellows, graduate assistants, or scholars. It endeavors to conserve, maintain, and promote the health of students. Consult the *Manual for Graduate Students* for details concerning facilities and services.

LIVING ACCOMMODATIONS—A variety of living accommodations are available including rooms in private homes, lodging houses, and to a limited extent in dormitories. Boarding houses as well as restaurants are available for meals. The cost varies considerably but has been estimated at approximately \$21 per week, including both board and room. The office of the Dean of Men and the office of the

ASSISTANTSHIPS AND OTHER AIDS

Dean of Women attempt to maintain a list of known vacancies. Prospective students should write to the appropriate office well in advance of the beginning of school because it may be very difficult to find a convenient location at the last minute.

Married students find accommodations in apartments, trailers, and rooms in private homes. Personal contact is essential, but assistance may be gained through contact with the office of the Dean of Men or an advertisement in the local newspaper.

Married students are eligible for residence in Eastview Terrace, a housing development consisting of small one- or two-bedroom units located on the campus. For details write to the Director of Housing, Old Main.

PLACEMENT SERVICE—The University Placement Service is designed to coordinate the placement activities of all the Colleges and departments of the University. The services of the following divisions are available to students without charge.

The Placement Service functions primarily as a clearing house, bringing together students, faculty members, and representatives of organizations that are seeking college-trained personnel. Summer jobs other than those at camps or resorts are listed at this office.

The Teacher Placement Division is maintained to assist seniors, alumni, and graduate students in all departments in securing teaching positions for which they are qualified.

The Student Employment Division offers assistance to students in finding part-time employment in town and on the campus, as well as summer employment at camps and resorts. Students must be registered to be informed of jobs.

The divisions of the University Placement Service are available to all students, regardless of level, who are in need of counseling or guidance on employment problems.

SENIOR STUDENT PRIVILEGES—A senior student of The Pennsylvania State University lacking for graduation not more than 4 credits may be admitted to the Graduate School, receiving full residence credit. A senior student in the last semester lacking more than 4 credits for graduation may not be admitted to the Graduate School, but may be admitted to the graduate (500) courses (with permission of the Dean of his College and the Dean of the Graduate School) so far as his schedule permits.

SUMMER SESSIONS—A series of sessions covering a total period of 12 weeks are arranged each summer. During this time there are excellent opportunities for graduate work in many fields. It is not, however, possible to provide all the facilities which are available during the academic year. Detailed information can be secured from the *Summer Sessions Complete Announcement*, which is published about April 1 and can be obtained by writing to the Director of Summer Sessions.

ASSISTANTSHIPS, FELLOWSHIPS, AND OTHER AIDS

ASSISTANTSHIPS—Three types of appointments as graduate assistants in teaching or research are available, as listed below. All of them grant exemption from the major fees but not from the health and welfare charge and other specific fees such as admission, late registration, and change of schedule. They are intended only for superior graduate students who are so situated financially that with the aid

ASSISTANTSHIPS AND OTHER AIDS

of these assistantships they will be able to carry the loads specified without having to seek additional employment. For further details see the *Manual for Graduate Students*.

Applications should be addressed to the head of the department in which service is to be rendered.

QUARTER-TIME GRADUATE ASSISTANTSHIPS—Appointments for the academic year (stipend \$590), or for the fiscal year (stipend \$780); service one-fourth time; program four-fifths.

HALF-TIME GRADUATE ASSISTANTSHIPS—Appointments for the academic year (stipend \$1180), or for the fiscal year (stipend \$1572); service one-half time; program two-thirds.

THREE-QUARTER TIME GRADUATE ASSISTANTSHIPS—Appointments for the academic year (stipend \$1770), or for the fiscal year (stipend \$2352); service three-fourths time; program one-half.

COUNSELORSHIPS—The Dean of Men has available a number of appointments as resident counselors in the men's dormitories. Their responsibility is to work for the social, academic, and emotional adjustment of the undergraduate residents. Specialized training in personnel work is desirable, though not essential.

These appointments are for the academic year and carry with them remission of fees for room and board, but not exemption from academic fees.

Applications should be addressed to the Dean of Men.

FELLOWSHIPS—Approximately 80 fellowships are available to enable superior graduate students to devote all their time to study and research. Fellows render no service, though in some cases they will be expected to conduct their research within broad fields specified by the donors. They will be expected to register for full-time graduate programs and not to accept additional employment. Fellowships yield stipends in varying amounts and carry with them exemption from the major fees, but not from the health and welfare charge and other specific fees such as admission, late registration, and change of schedule.

Requests for additional information and application forms should be addressed to the head of the major department concerned.

The fellowships which are available will vary somewhat from year to year, but the following are typical of those which were awarded for 1953-54:

ALLEGHENY LUDLUM FELLOWSHIP—Open to graduate students in metallurgy for studies in steelmaking.

ALLIED CHEMICAL AND DYE FELLOWSHIP—Open to graduate students in chemical engineering.

ALLIED CHEMICAL AND DYE FELLOWSHIP—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

ALLIED CHEMICAL AND DYE FELLOWSHIP IN CHEMISTRY—Open to graduate students in organic chemistry.

AMERICAN CYANIMID FELLOWSHIP—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

AMERICAN PETROLEUM INSTITUTE FELLOWSHIPS (8)—Open to graduate students in chemistry and physics for research in the synthesis and properties of high molecular weight hydrocarbons.

ASSISTANTSHIPS AND OTHER AIDS

AMERICAN PLANT FOOD COUNCIL FELLOWSHIP—In support of research in fertilizer requirements of grasses and legumes.

AMERICAN POTASH INSTITUTE FELLOWSHIP—In support of research in potassium fixation in soils.

CALIFORNIA COMPANY FELLOWSHIP—Open to graduate students in geology and mineralogy for studies in sedimentary petrology or stratigraphy.

CO-OPERATIVE PROGRAM FELLOWSHIP—Open to graduate students in metallurgy.

DANFORTH FOUNDATION FELLOWSHIPS—For graduate students in the natural sciences, social sciences, humanities, and other fields of specialization preparing themselves for college teaching, who see in teaching a vocation of Christian service.

DOW CORNING FELLOWSHIPS—Open to graduate students in chemistry for fundamental studies in organosilicon compounds.

DU PONT FELLOWSHIP IN CHEMISTRY—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

DU PONT FELLOWSHIP IN MECHANICAL ENGINEERING—Open to graduate students in mechanical engineering, preferably those working toward the Ph.D. degree.

ELI LILLY FELLOWSHIPS (2)—Open to graduate students in physics for studies in crystal analysis.

ELLIOTT FELLOWSHIP IN ENGINEERING RESEARCH—An annuity provided by W. S. Elliott of Pittsburgh for a student in engineering who must be a graduate of this University.

GENERAL MOTORS FELLOWSHIP—Open to graduate students in mechanical engineering for studies relating to internal combustion engines.

GRANGE LEAGUE FEDERATION FELLOWSHIP—In support of research in pasture renovation.

GULF COMPANY FELLOWSHIP IN MINERALOGY—Open to graduate students in mineralogy for studies in sedimentation.

GULF COMPANY FELLOWSHIP IN PHYSICS—In support of graduate work in the field of X-ray crystallography.

HAMILTON STANDARD FELLOWSHIPS (3)—Open to graduates of this University in aeronautical engineering, electrical engineering, and mechanical engineering.

INTERNATIONAL MINERALS AND CHEMICAL FELLOWSHIP—In support of research in magnesium requirements of soils and crops.

NEW YORK AND PENNSYLVANIA COMPANY FELLOWSHIP—In support of research in the effects of Clarion extract on physical conditioning of soils.

PENNSYLVANIA CO-OPERATIVE POTATO GROWERS ASSOCIATION FELLOWSHIP—In support of research in soil and fertility factors affecting yields and quality of potatoes.

PENNSYLVANIA CO-OPERATIVE WILDLIFE RESEARCH FELLOWSHIPS (3)—Funds supplied by the Pennsylvania Game Commission for investigations dealing with wildlife management.

PENNSYLVANIA GRANGE LEAGUE FEDERATION FELLOWSHIP—For the support of research in poultry nutrition, with major interest in biochemistry.

ROLL MANUFACTURERS INSTITUTE FELLOWSHIP—Open to graduate students in metallurgy for studies in cast iron.

SHELL COMPANY FELLOWSHIP IN CHEMICAL ENGINEERING—In support of graduate work in chemical engineering, preferably for students in their last year of doctoral work.

ASSISTANTSHIPS AND OTHER AIDS

SHELL COMPANY FELLOWSHIP IN CHEMISTRY—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

SINCLAIR FELLOWSHIP IN PETROLEUM PRODUCTION—Available to graduate students in petroleum and natural gas engineering for studies in petroleum production.

STACKPOLE FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy for studies in powder metallurgy.

STANOLIND FELLOWSHIP IN PETROLEUM AND NATURAL GAS ENGINEERING—Available to graduate students in petroleum and natural gas engineering for studies in petroleum production.

TITAN METAL FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy for studies in copper-base alloys.

UNION CARBIDE AND CARBON FELLOWSHIP—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

U. S. GOLF ASSOCIATION FELLOWSHIP—In support of research in aeration and soil conditioners.

WEIRTON FELLOWSHIP—Open to graduate students in metallurgy for studies in steelmaking.

JOHN W. WHITE FELLOWSHIP—Awarded to one graduate of The Pennsylvania State University each year on the basis of scholarship, need, character, and attitude. The recipient may enroll in any approved college or university.

In addition, numerous grants are available from governmental agencies, industrial concerns, and foundations for the support of investigations of particular problems. Many of these permit full-time study and carry the same fee exemptions as the fellowships listed above. Detailed information can be secured from departments.

LOAN FUNDS—Loan funds are available to a limited extent. Applications should be addressed to the Dean of Men or the Dean of Women.

SCHOLARSHIPS—A number of scholarships are awarded annually. Applications should be addressed to the Dean of the Graduate School and must be received by March 1 in order to be considered for the following academic year.

GRADUATE SCHOLARSHIPS—Forty are awarded each year. These scholarships carry no stipend but do grant exemption from all major fees. Recipients are required to take a full program of graduate work and may be required to render some service.

A.A.U.W. SCHOLARSHIP—The State College Branch of the American Association of University Women has established a scholarship for a woman graduate student. The amount of the award varies and does not include fee exemption.

STUDENT EMPLOYMENT—Many students depend partly on their own earnings to help meet their expenses. The Student Employment Office, 112 Old Main, gives information on part-time jobs. Students not holding fellowships or assistantships who want part-time jobs should register with the Student Employment Office as soon as their class schedules have been arranged. While some students find regular part-time work, many of them depend on a series of odd jobs, some of which are of a continuing nature.

*GRADUATE
COURSES*

COURSE ABBREVIATIONS

Acctg.	Accounting	Geol.	Geology
Aero.E.	Aeronautical Engineering	G.&G.	Geophysics and Geochemistry
A.B.Ch.	Agricultural and Biological Chemistry	Ger.	German
		Greek	Greek
Agr.Ec.	Agricultural Economics	HI.Ed.	Health Education
Agr.Ed.	Agricultural Education	Hist.	History
Agr.E.	Agricultural Engineering	H.Art	Home Art
Agr.	Agriculture—General	H.C.Rel.	Home-Community Relationships
Agro.	Agronomy		
A.H.	Animal Husbandry	H.E.Ed.	Home Economics Education
A.Ntr.	Animal Nutrition	Hort.	Horticulture
Anthy.	Anthropology	HI.Adm.	Hotel Administration
Archy.	Archaeology	Hs.Eqp.	Housing and Home Equipment
A.E.	Architectural Engineering		
Arch.	Architecture	I.Arts	Industrial Arts
Art	Art	Ind.Ed.	Industrial Education
Art Ed.	Art Education	I.E.	Industrial Engineering
Astro.	Astronomy	In.Adm.	Institution Administration
Bact.	Bacteriology	Int.Un.	International Understanding
Bot.	Botany	It.	Italian
B.Stat.	Business Statistics	Journ.	Journalism
Cer.	Ceramics	Latin	Latin
Ch.E.	Chemical Engineering	Lib.Sc.	Library Science
Chem.	Chemistry	Math.	Mathematics
Ch.Fm.	Child Development and Family Relationships	M.E.	Mechanical Engineering
C.E.	Civil Engineering	M.E.Des.	Machine Design
Cl.Tex.	Clothing and Textiles	M.E.Lab.	Mechanical Engineering Laboratory
Com.	Commerce		
C.Con.S.	Commercial Consumer Services	Met.	Metallurgy
		Metco.	Meteorology
C.Lit.	Comparative Literature	Min.Ec.	Mineral Economics
D.H.	Dairy Husbandry	Min.Pr.	Mineral Preparation
Dram.	Dramatics	Min.	Mineralogy
Econ.	Economics	Mng.	Mining
Ed.	Education	Music	Music
E.E.	Electrical Engineering	Mus.Ed.	Music Education
El.Lab.	Electrical Engineering Laboratory	Pet.E.	Petroleum and Natural Gas
		Phil.	Philosophy
Eng.	Engineering	Ph.Ed.	Physical Education
Mchs.	Engineering Mechanics	Phys.	Physics
Engl.	English	Pol.S.	Political Science
E.Cmp.	English Composition	Port.	Portuguese
E.Lit.	English Literature	P.H.	Poultry Husbandry
Ent.	Entomology	Psy.	Psychology
H.Mgmt.	Family Economics and Home Management	P.U.	Public Utilities
		Recr.	Recreation
Fd.Ntr.	Foods, Nutrition, and Health	R.Soc.	Rural Sociology
For.	Forestry	Rus.	Russian
Fr.	French	Soc.	Sociology
Fuel T.	Fuel Technology	Sp.	Spanish
Gen.H.E.	General Home Economics	Spch.	Speech
Geog.	Geography	Sph.Ed.	Speech Education
		Zool.	Zoology

GRADUATE COURSES

NUMBERING SYSTEM

The course descriptions which follow are arranged alphabetically. If any course cannot be located readily, refer to the table of contents, pages 2 and 3. Courses are numbered as follows:

UNDERGRADUATE COURSES (1 to 399) are general courses accepted in fulfillment of the requirements for the bachelor's degree.

UPPER-CLASS AND GRADUATE COURSES (400 to 499) are advanced courses open for credit to undergraduate students of at least junior standing and to graduate students under the restriction that no more than 12 credits in these courses may be offered in fulfillment of the minimum requirements for the M.A. and M.S. degrees.

GRADUATE COURSES (500 to 599) are for graduate students only. The name of the instructor may follow the description. Seniors not required to carry a full program for graduation, with permission of the Dean of the College in which they are enrolled and of the Dean of the Graduate School, may attend such courses and be allowed credit under special conditions. *Many departments reserve the right to say which of certain graduate courses may be given in any semester; the heads of departments should be consulted.*

RESEARCH, THESIS, DISSERTATION (600 and 610): In general, students registering for research or for work on a master's thesis or doctoral dissertation will, if it is to be done in residence, use course number 600 preceded by the appropriate course abbreviation. Thus Aero.E. 600 signifies research or thesis or dissertation in Aeronautical Engineering. In case such work has been authorized as off-campus work for nonresident students, the course number 610 will be used. Credits will be 1 to 15 per semester. There will be no specific listing of the 600 and 610 courses in the departmental listings.

EXPLANATORY NOTE: The figures in parentheses following the course title show the number of credits granted for that course. Many graduate courses are offered in the summer sessions. When these courses are also given during the regular academic year, they are not listed separately as summer session courses in this announcement. For a complete list of courses given during a specific summer session, consult the *Complete Announcement of the Summer Sessions* for that year. In the section which follows, courses given during the summer session (*but not during the regular academic year*) have numbers followed by the letter "S." Courses given in extension only have numbers followed by the letter "X."

ACCOUNTING

PROFESSOR CHARLES J. ROWLAND, C.P.A., M.B.A.

Head of the Department of Accounting and Business Statistics

500. ACCOUNTING SEMINAR (3) Prerequisite: Acctg. 6. *Professor Rowland*
501. ACCOUNTING SYSTEMS (3) Principles of system design including practical application to special businesses, such as financial institutions, department stores, public utilities, etc. Prerequisite: Acctg. 401. *Professor Rowland*

ACCOUNTING

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. CONTROLLERSHIP (3)	<i>Professor Nelson</i>
401. ADVANCED ACCOUNTING (3)	<i>Professor Devereaux</i>
403. ADVANCED AUDITING (3-9)	<i>Professor Rowland</i>
404. BUDGETARY CONTROL (3)	<i>Professor Nelson</i>
405. ADVANCED COST ACCOUNTING (3)	<i>Professor Nelson</i>
406. ADVANCED FEDERAL TAX ACCOUNTING (3)	<i>Professor Rowland</i>
407. C.P.A. REVIEW (3)	<i>Professor Rowland</i>

AERONAUTICAL ENGINEERING

PROFESSOR DAVID J. PEERY, M.S.E., C.E., Ph.D.

Head of the Department

501. AIRPLANE STABILITY AND CONTROL (3) General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aero.E. 403.
503. AIRPLANE PERFORMANCE (3) Methods of performance prediction and performance flight testing for high-speed aircraft and missiles. Prerequisite: Aero.E. 403.
504. ROTARY WING AIRCRAFT (3) Types of rotary wing aircraft; helicopter performance, stability, and control; structural and vibration problems. Prerequisites: Aero.E. 403, 409.
505. AIRCRAFT VIBRATION AND FLUTTER (3) Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending, torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aero.E. 1, M.E.Des. 8.
506. ADVANCED AIRCRAFT STRUCTURES (3) Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing deformations of multi-cell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisite: Aero.E. 409.
507. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3) Types of jet propulsion installations, thermodynamic cycles, analysis of compressors, combustion chambers, and turbines. Prerequisite: Aero.E. 410.
510. AERODYNAMICS OF COMPRESSIBLE FLUIDS (3) One-dimensional motion, shock waves, flow in nozzles, two-dimensional flow, airfoil theory, Prandtl-Meyer flow, method of characteristics. Prerequisites: Aero.E. 412, M.E. 2.
511. AERODYNAMICS OF A PERFECT FLUID (3) Euler's dynamic equations, complex potential, conformal transformation, thin airfoils, Biot-Savart law; Prandtl three-dimensional airfoil theory. Prerequisite: Aero.E. 412.
512. AERODYNAMICS OF A VISCOUS FLUID (3) Navier-Stokes equations, incompressible and compressible boundary layer theory, jet and wake problems, hydrodynamic stability, turbulence. Prerequisite: Aero.E. 412.

AERONAUTICAL ENGINEERING

513. RESEARCH IN AERONAUTICAL ENGINEERING (1-15 per semester) Investigation of a theoretical or experimental project in aeronautical engineering.
514. AERONAUTICAL ENGINEERING SEMINAR (1 per semester) Current literature and special problems in aeronautical engineering.
515. AERODYNAMICS (3) Airflow, airplane performance. For students with undergraduate training in science or engineering curriculums other than aeronautical engineering.
516. AIRCRAFT STRUCTURES (3) Analysis of semi-monocoque aircraft structures. For students with undergraduate training in science or engineering curriculums other than aeronautical engineering.
517. DYNAMICS OF AIRCRAFT (3) Steady and transient vibrations, Laplace transformation, electrical analogies; introduction to flutter, dynamic stability, aeroelasticity, and servomechanisms.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401a,b,c. AERONAUTICAL ENGINEERING PROJECTS (2-12)
402. AIRPLANE ENGINE DESIGN (4)
403. APPLIED AERODYNAMICS (3)
404. AIRPLANE DESIGN (4)
407. ROTARY WING AIRCRAFT (3)
408. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3)
409. AIRPLANE DETAIL DESIGN (3)
410. AIRCRAFT PROPULSION (3)
411. AIRCRAFT STRUCTURES (3)
412. THEORETICAL AERODYNAMICS (3)
413. GUIDED MISSILES (3)

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

PROFESSOR HOWARD O. TRIEBOLD, M.S., Ph.D.

Head of the Department

501. ENZYMES (2) Investigations and theories concerning nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: A.B.Ch. 437. *Professor Jensen*
502. PHYSICAL CHEMISTRY OF THE CELL (3) Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: A.B.Ch. 426. *Professor Lisse*
503. RESEARCH (3-15) Prosecution of an assigned problem under the guidance of an instructor. Prerequisite: A.B.Ch. 417. For certain problems additional courses may be considered as prerequisite.
505. VITAMINS AND DIETARY DEFICIENCY DISEASES (2) Lectures, conferences, and assigned reading. Prerequisite: A.B.Ch. 437. *Professor Guerrant*

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

506. VITAMIN ASSAY METHODS (2) Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: A.B.Ch. 505.
Professor Guerrant
- 507a. SEMINAR IN PHYSIOLOGICAL CHEMISTRY AND NUTRITION (1)
Professors Guerrant, Anderson, Boucher, Miller, and Pritham
- 507b. SEMINAR IN FOODS AND ANALYTICAL CHEMISTRY (1)
Professors Triebold, Althouse, and Shigley
- 507c. SEMINAR IN PLANT, SOIL, AND INSECTICIDE CHEMISTRY (1)
Professors Frear and Jensen
508. RESEARCHES IN PLANT CHEMISTRY (3) Lectures and assigned readings reviewing the more important chemical investigations in plant chemistry. Prerequisite: A.B.Ch. 437.
Professor Jensen
509. BIOCHEMICAL METHODS (3) An advanced laboratory course involving special methods used in biochemical research on plant and animal materials. Prerequisite: A.B.Ch. 437.
Professor Anderson
510. PROTEINS (2) Chemical constitution of proteins, their physical and biochemical properties, their function in nutrition, and their fate in metabolism. Prerequisite: A.B.Ch. 437.
Professor Anderson
511. CARBOHYDRATES (2) Study of research work dealing with carbohydrates and their metabolism in plant and animal organisms. Prerequisite: A.B.Ch. 437.
Professor Jensen
512. LIPIDS (2) Investigations on biochemistry of fats and related substances. Prerequisite: A.B.Ch. 437.
Professor Triebold
513. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (4) Laboratory course, quantitative in nature, valuable as preparation for A.B.Ch. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: A.B.Ch. 425 or Chem. 41, 43.
Professor Lisse
515. BIOMETRY (2) Application of statistical methods to research problems in biochemistry and biology. Prerequisite: Agr. 400.
Professor Miller
516. CHEMISTRY OF INSECTICIDES AND FUNGICIDES (2) Lectures and assigned readings dealing with chemical investigations of materials used in the control of insects and plant diseases. Prerequisites: Chem. 30, 31; A.B.Ch. 425 or Chem. 41, 43; A.B.Ch. 417.
Professor Frear
517. ENDOCRINE SECRETIONS (2) Chemistry of hormones and their physiological significance. Prerequisite: A.B.Ch. 437.
Professor Pritham
518. MINERAL METABOLISM (2) Utilization and function of mineral elements in animal nutrition. Prerequisite: A.B.Ch. 437.
Professor Boucher

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

403. DAIRY CHEMISTRY (3) *Professor Shigley*

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

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| 404. FOOD CHEMISTRY (4) | <i>Professor Triebold</i> |
| 413. PRINCIPLES OF ANIMAL NUTRITION (3) | <i>Professor Miller</i> |
| 417. METHODS OF AGRICULTURAL ANALYSIS (4) | <i>Professor Triebold</i> |
| 418. PLANT ANALYSIS (4) | <i>Professor Jensen</i> |
| 421. CHEMISTRY OF MILLING AND BAKING (3) | <i>Professor Triebold</i> |
| 425. BIOPHYSICAL CHEMISTRY (4) | <i>Professor Lisse</i> |
| 426. BIOCOLLOIDS (3) | <i>Professor Lisse</i> |
| 427. POTENTIOMETRIC THEORY AND TECHNIQUE (3) | <i>Professor Lisse</i> |
| 437. GENERAL BIOCHEMISTRY (5) | <i>Professor Pritham</i> |
| 438. PHYSIOLOGICAL CHEMISTRY (CLINICAL METHODS) (5) | <i>Professors Anderson and Pritham</i> |
| 439. PROBLEMS IN AGRICULTURAL CHEMISTRY (3-5) | |
| 440. PLANT BIOCHEMISTRY (3) | <i>Professor Jensen</i> |

AGRICULTURAL ECONOMICS

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.

Head of the Department of Agricultural Economics and Rural Sociology

500. SEMINAR IN AGRICULTURAL ECONOMICS (1-6) Review of current literature and problems.
503. RESEARCH METHODS IN FARM MANAGEMENT (1-3) Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Agr.Ec. 6, Econ. 14. *Professor Barr*
504. AGRICULTURAL PRICE AND INCOME POLICY (3) Analysis of farm prices, income consequences for producers and consumers, and effects on resource use; evaluation of policy, considerations in policy making. Prerequisites: Agr.Ec. 420, Econ. 405. *Professor Brandow*
505. ADVANCED AGRICULTURAL STATISTICS (3) Multiple correlation, curve fitting, analysis of variance, selection of samples, and other techniques applicable to the rural social sciences. Prerequisite: 3 credits in statistics. *Professor Brandow*
506. ECONOMIC PROBLEMS IN MARKETING SPECIFIC AGRICULTURAL PRODUCTS (1-4)
507. SEMINAR IN FARM MANAGEMENT (1-6) Special problems relating to organization and operation of the farm business. Prerequisites: Agr.Ec. 6, Econ. 14.
508. CURRENT LITERATURE SEMINAR IN ECONOMICS OF AGRICULTURAL MARKETING (1-3)
510. ADVANCED FARM FINANCE (1-3) Problems and policies in agricultural credit, insurance, and farm financial management. *Professor Miller*
515. ECONOMIC PROBLEMS IN THE MARKETING OF DAIRY PRODUCTS (3) Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing. *Professor Pierce*
517. PROBLEMS AND POLICIES OF FARMER CO-OPERATIVES (3) Specific types of co-operative organizations, their problems, policies, and progress; relationships existing among co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Agr. Ec. 17. *Professor Becker*

AGRICULTURAL ECONOMICS

522. ADVANCED FARM APPRAISAL (3) Land value theory; methods of land valuation; field practice in farm appraisal.

525. RESEARCH METHODS IN RURAL SOCIAL SCIENCES (2) Scientific method in planning and conducting research. Prerequisite: 9 credits in social sciences.

Professor John

526. RESEARCH METHODS IN AGRICULTURAL ECONOMICS (2) Application of economic and statistical principles.

Professor John

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400, 400X. PUBLIC POLICIES IN AGRICULTURE (1-2)

407. ADVANCED FARM MANAGEMENT (3)

Professor Miller

420. AGRICULTURAL PRICES (3)

Professor Brandow

421. LAND ECONOMICS (3)

Professor Frey

440. ECONOMICS OF AGRICULTURAL PRODUCTION (3)

AGRICULTURAL EDUCATION

PROFESSOR HENRY S. BRUNNER, M.S., Ph.D.

Head of the Department

501v. HISTORY OF AGRICULTURAL EDUCATION (1-3) Development of training for agricultural vocations; emphasis upon introduction of agricultural instruction into the high school program.

Professor Hall

502v, 502vX. TEACHING VOCATIONAL AGRICULTURE (1-3) Organization of instruction with respect to vocational objectives, methods of presentation, supervision of practice, pupil evaluation of goals, and follow-up.

Professor Stevens

503v, 503vX. RESEARCH IN AGRICULTURAL EDUCATION (1-6 per semester) Individual study problems in various phases of agricultural education, such as evaluation of teaching, teaching procedures, and teacher preparation.

Professor Brunner and Staff

504v. AGRICULTURAL EDUCATION SEMINAR (1 per semester)

Professor Brunner and Staff

506v, 506vX. PROBLEMS IN COUNTY VOCATIONAL SUPERVISION (1-3) Needs of county supervisors and vocational directors; co-operation with county superintendents, supervisory duties, plans of work, community meetings and organizations.

Professor McClay

508v. STATE AND COUNTY ADMINISTRATION AND SUPERVISION OF AGRICULTURAL EDUCATION (1-3) Organization and administration of state, county, township, and district systems of agricultural education; state and federal legislation.

Professor McClay

509v, 509vX. TEACHER TRAINING IN AGRICULTURAL EDUCATION (1-6) Construction of college curriculums, courses of study, and organization of college departments for training agricultural teachers.

Professor Brunner

AGRICULTURAL EDUCATION

520v, 520vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4)
Methods of procedure in investigation and experimentation in education, accompanied by a critical examination of studies made in agricultural education.

Professor Stevens

521v, 521vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4)
Continuation of Agr.Ed. 520v; emphasis upon statistical techniques for students' individual problems.

Professor Stevens

522v, 522vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) Organization and administration of agricultural education in its local bearings; field laboratory surveys of local school conditions.

Professor Brunner and Staff

523v, 523vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4)

Professor Brunner and Staff

524v, 524vX. ANNUAL PLAN OF WORK (1-3) Detailed study of the agricultural education needs of each student's community and outlining annual plans of work.

Professor Brunner

530v. AGRICULTURAL COLLEGE TEACHING (3) Selection and organization of subject matter for specific courses, methods of learning, teaching devices, technique of teaching, and measurements of results of teaching.

Professor Brunner

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

416v. RURAL EDUCATION (3)

Professor Hall

417v, 417vX. RURAL EDUCATION SURVEY (2)

Professor Brunner

418v, 418vX. SURVEY OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3)

Professor Brunner

420v, 420vX. ADVANCED VISUAL AND OTHER SENSORY AIDS IN TEACHING AGRICULTURE (1-6)

Professor McClay

422v, 422vX. SUPERVISION OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3)

Professor McClay

434v, 434vX. AGRICULTURAL DEVELOPMENTS (1-6)

Professor Brunner

AGRICULTURAL ENGINEERING

PROFESSOR ARTHUR W. CLYDE, M.S.

Acting Head of the Department

500. ADVANCED ELECTRO-AGRICULTURE (1-6) Investigations in the application of electrical energy to processing, storing, and handling agricultural products. Seminar, written reports.

501. ADVANCED FARM MACHINERY (1-6) Application of agricultural engineering principles to design and operation of farm machinery. Prerequisite: Agr.E. 10.

508. ADVANCED PROBLEMS IN FARM MECHANICS (1-15) Problems in farm shop practice and agricultural engineering related to the farm mechanics program of vocational education in agriculture. Prerequisites: Agr.E. 8, 14; or teaching experience in farm mechanics.

AGRICULTURAL ENGINEERING

509. RESEARCH IN AGRICULTURAL ENGINEERING (1-4)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. AGRICULTURAL ENGINEERING PROBLEMS AND SEMINAR (1-7)

401a,b,c,dS. FARM MECHANICS FOR TEACHERS OF VOCATIONAL AGRICULTURE (1½-6)

402. FUNCTIONAL DESIGN OF FARM STRUCTURES (3)

405. ADVANCED FARM ELECTRIFICATION (3)

406. ADVANCED DAIRY ENGINEERING (3)

AGRICULTURE—GENERAL

Consult ASSOCIATE DEAN RUSSELL B. DICKERSON, M.S., Ph.D.

The following course may be taken for graduate credit under the restrictions in force:

400. INTRODUCTORY BIOMETRY (3)

AGRONOMY

PROFESSOR HOWARD B. SPRAGUE, B.S., M.S., Ph.D.

Head of the Department

501. ADVANCED SOIL FERTILITY (4) Interpretation of fertility experiments and diagnosis of soil-plant relationships through field appraisal, analysis, and plant symptoms. Prerequisites: Agro. 431, Bot. 406. *Professor Merkle*

503. AGRONOMY SEMINAR (1) Weekly meeting where papers and discussions will be presented by students and staff members. Each student will present a paper on some phase of his major subject.

506. SOIL CHEMISTRY (4) Analyses of important chemical and biochemical reactions occurring in soils, conditions which control these reactions and their importance in soil genesis and plant growth; laboratory work in the more typical and significant analytical procedures; lectures, review of current literature, and practicum. Prerequisites: Agro. 419; A.B.Ch. 417 or Chem. 20. *Professor Satchell*

507. SOIL PHYSICS (4) Physical properties of the soil; factors affecting them; their measurements, evaluation, and influence in determination of soil productivity. Prerequisites: Agro. 419, Phys. 215, A.B.Ch. 425. *Professor Alderfer*

509. GENETICS OF CROP PLANTS (3) Inheritance in crop plants with particular reference to factor interaction, genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 422.

510. THE APPLICATION OF CYTOGENETICS TO PLANT BREEDING (3) Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 505.

511. THE BREEDING OF FARM CROPS (3) Application of genetic principles to improvement of crop plants. Prerequisite: Hort. 7.

512. **FIELD PLOT TECHNIQUE** (4) Ramifications of analysis of variance technics; combining and analyzing data from several experiments; selection of valid error terms. Prerequisite: Math. 8 or Agr. 400. *Professor Fortmann*
516. **HUMUS** (2) Origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 419, 431. *Professor Richer*
517. **FARM CROPS ECOLOGY** (2) Ecological factors influencing distribution and production of field crops. Prerequisites: Math. 8, Bot. 406. *Professor Huber*
518. **GROWTH AND MANAGEMENT OF FORAGE CROPS** (3) Factors affecting growth and development of forage crops with particular reference to effects of environment, defoliation, and management practices. Prerequisites: Agro. 423, Bot. 406. *Professor V. G. Sprague*
519. **THE NATURE OF SOIL MINERALS** (3) Modern methods for identification of the constituent minerals of soils and their relation to soil classification and agricultural practices. Prerequisites: Agro. 1, Chem. 2, Geol. 31 or 32. *Professor Jeffries*
520. **SPECIAL SOILS PROBLEMS** (1-6 per semester) Provides basic or practical training in the soils sciences by means of library, field, and laboratory assignments.
545. **THE APPLICATION OF STATISTICS TO FIELD EXPERIMENTS** (4) Use of advanced experimental designs in planning, analyzing, and interpreting experiments; includes lattice designs, factorials, confounding, simple and multiple covariance techniques. Prerequisite: Agro. 512. *Professor Fortmann*
550. **SPECIAL CROPS PROBLEMS** (1-6 per semester) Provides basic or practical training in the crops sciences by means of library, field, and laboratory assignments.
582. **SEMINAR IN THE BREEDING AND GENETICS OF FARM CROPS** (1-8 per semester)
- 583S. **LABORATORY METHODS IN FIELD CROPS** (3) Prerequisite: Agro. 512.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 416. SOIL CLASSIFICATION (5) | <i>Professor Higbee</i> |
| 419. SOIL PROPERTIES (5) | <i>Professor Merkle</i> |
| 422. SOIL CONSERVATION (3) | <i>Professor Alderfer</i> |
| 423. PASTURE AND GRASSLAND MANAGEMENT (3) | <i>Professor Washko</i> |
| 431. SOIL FERTILITY AND MANAGEMENT (3) | <i>Professor Merkle</i> |
| 490. AGRONOMIC PRACTICES (1-6) | |

ANIMAL HUSBANDRY

PROFESSOR WILLIAM L. HENNING, M.S., Ph.D.
Head of the Department

501. **PEDIGREE STUDY** (1-6) Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book. *Professor Henning*

ANIMAL HUSBANDRY

502. RESEARCH IN MEATS (1-6 per semester) Investigation of methods for handling, cutting, processing, freezing, and curing meat and meat products. Prerequisite: A.H. 421. *Professor Ziegler*
503. LIVESTOCK MANAGEMENT (3) Handling of purebred herds and flocks; relation of livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding.
504. LIVESTOCK HEALTH PROBLEMS (3) Problems dealing with regulations governing movement of livestock with special reference to control measures applicable to diseases and disease groups common to men and animals. Prerequisites: A.H. 5, 415. *Professor Bortree*
505. ADVANCED ANIMAL BREEDING (1-5) Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22. *Professor Henning*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

415. ADVANCED ANATOMY AND PHYSIOLOGY (3) *Professor Bortree*
421. ADVANCED MEAT STUDIES (3) *Professor Ziegler*
423. ADVANCED STOCK JUDGING (2) *Professor Henning*
424. ANIMAL HUSBANDRY SURVEY (1)
426. LIVESTOCK MARKETS AND MARKETING (3)
431. ADVANCED MEAT JUDGING (1)

ANIMAL NUTRITION

PROFESSOR RAYMOND W. SWIFT, M.S., Ph.D.
Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

401. PHYSIOLOGY OF NUTRITION (3) *Professor Black*
402. PHYSIOLOGY OF NUTRITION (3) *Professor French*

ANTHROPOLOGY

PROFESSOR ROBERT E. CLARK, M.A., Ph.D.
Acting Head of the Department of Sociology

540. THEORY AND METHOD IN ANTHROPOLOGY (3) Theory and method used in culture-historical, sociological, and psychological interpretations. *Professor Mook*
545. SEMINAR IN ANTHROPOLOGY (1-9) Critical analysis of research in selected areas of regional ethnography and ethnological theory. Prerequisites: Anthy. 445, Soc. 45. *Professor Mook*

ANTHROPOLOGY

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 441. FOLK SOCIETY (3) | Professor Mook |
| 443. ANTHROPOLOGY OF THE OLD WORLD (3) | Professor Mook |
| 445. PRIMITIVE SOCIETY (3) | Professor Mook |

ARCHAEOLOGY

PROFESSOR ROBERT E. CLARK, M.A., Ph.D.
Acting Head of the Department of Sociology

The following courses may be taken for graduate credit under the restrictions in force:

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| 400-401. ARCHAEOLOGY OF THE NEAR EAST (3 each) | Professor Matson |
| 402-403. ARCHAEOLOGY OF THE NEW WORLD (3 each) | Professor Matson |

ARCHITECTURAL ENGINEERING

Consult PROFESSOR LOUIS A. RICHARDSON, M.S.

502. ARCHITECTURAL ENGINEERING (3-8) Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar.
Professor Richardson and Staff
503. ARCHITECTURAL ENGINEERING (4-8) Continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed constructions are studied. Practicum and seminar.
Professor Fox
504. ARCHITECTURAL ENGINEERING (4-8) Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar. *Professor Richardson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 401. ARCHITECTURAL ENGINEERING (3) |
| 402. ARCHITECTURAL ENGINEERING (4) |
| 403. ARCHITECTURAL ENGINEERING (3) |
| 420. ARCHITECTURAL ENGINEERING (3) |
| 421. ARCHITECTURAL ENGINEERING (4) |
| 422. ARCHITECTURAL ENGINEERING (3) |
| 423. ARCHITECTURAL ENGINEERING THESIS (2) |
| 424. ARCHITECTURAL ENGINEERING THESIS (5) |

ARCHITECTURE

ARCHITECTURE

PROFESSOR MILTON S. OSBORNE, M.S.

Head of the Department

501. ARCHITECTURAL DESIGN (4-8) Problems in advanced planning and design, including study of group composition. Practicum and seminar.

Professor Osborne and Staff

502. ARCHITECTURAL RESEARCH (2-12) Prosecution of assigned problems under the guidance of an instructor.

Professor Osborne and Staff

503. ARCHITECTURAL HISTORY RESEARCH (3-12) Original research in architectural history. Seminar and written reports.

Professor Dickson and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

410. ADVANCED ARCHITECTURAL DESIGN (2-12) *Professor Osborne and Staff*

411. ADVANCED ARCHITECTURAL DESIGN (8)

412. ADVANCED ARCHITECTURAL DESIGN AND THESIS (8)

421. CONTEMPORARY ARCHITECTURE (3) *Professor Norton*

ART

Consult PROFESSOR HAROLD E. DICKSON, M.A., Ph.D.

(See also courses in Art Education below.)

500. ART RESEARCH (2-6) Prosecution of assigned problems under the guidance of an instructor.

Professor Galbraith

501. ITALIAN PAINTING (2-6) Investigations of early Italian painting. Seminar, written reports.

Professor Dickson

502. MEDIEVAL SCULPTURE (2-6) Sculpture of Italy and France from the 9th to the 13th centuries. Seminar, written reports.

Professor Norton

503. ART HISTORY RESEARCH (3-12) Original investigation in art history, to be pursued independently or concurrently with course work in particular fields. Prerequisite: 6 credits in history of art.

Professor Dickson and Staff

504. SEMINAR: ART LITERATURE AND ICONOGRAPHY (2-6) Methods of research in the fine arts; survey of the literature of art; studies in iconography. Prerequisite: 6 credits in history of art.

Professor Dickson and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. OIL PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9)

- 403S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Professor Dickson*

- 404S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Professor Dickson*

410. WATER-COLOR PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9) *Professor Case*

- 442S. ART OF THE MIDDLE AGES AND RENAISSANCE IN ITALY (3)
 443S. ART IN AMERICA (3)
 444S. ART IN NORTHERN EUROPE (3)
 490. LIFE DRAWING (3)

Professor Case

ART EDUCATION

Consult PROFESSOR VIKTOR LOWENFELD

514. FUNCTIONAL RELATIONSHIPS IN CRAFTS (3) Relationships of material design and purpose in crafts discussed by means of outstanding products of different materials, periods, and cultures. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts. *Professor Emerson*
 534. CREATIVE ART ACTIVITY FOR THE HANDICAPPED (3) Specific methods for development of creative art activity with the physically, mentally, emotionally, and socially handicapped; adjustive effect upon them. Prerequisite: 6 credits in art education or 6 in special education or 6 in psychology. *Professor Lowenfeld*
 586. RESEARCH IN ART EDUCATION (3-9) Current experiments in art education; required of students working for a master's degree in art education. *Professor Lowenfeld*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

402. METHODS OF TEACHING DRAWING IN THE GRADES (2-3) *Professor Emerson*
 404. METHODS OF GRAPHICS AND ILLUSTRATIONS (3) *Professor Emerson*
 414, 414X. ADVANCED CRAFTS FOR TEACHERS (3-6)
 434, 434X. ART APPRECIATION IN THE EDUCATIONAL PROGRAM (2-3)
 434b, 434bX. ART IN THE ELEMENTARY SCHOOL (2-3) *Professor Lowenfeld*
 434c, 434cX. ART IN THE SECONDARY SCHOOL (2-3) *Professor Mattil*
 434d. ART SUPERVISION (3) *Professor Mattil*
 486, 486X. CURRENT PROBLEMS IN ART EDUCATION (2-3) *Professor Lowenfeld*
 487. MURAL PAINTING IN SCHOOLS (3) *Professor Lowenfeld*
 488. ADVANCED MURAL PAINTING IN SCHOOLS (3) *Professor Lowenfeld*

ASTRONOMY

PROFESSOR JOHN A. SAUER, M.S., Ph.D.
Head of the Department of Physics

The following courses may be taken for graduate credit under the restrictions in force:

430. GENERAL ASTRONOMY FOR TEACHERS (3)
 486. ASTRONOMICAL PHOTOGRAPHY (3)
 490-491. INTRODUCTION TO ASTROPHYSICS (3 each)

BACTERIOLOGY

BACTERIOLOGY

PROFESSOR ROBERT W. STONE, Ph.D.

Head of the Department

- 506. RESEARCH (1-15 per semester) Special problems in microbiology.
- 507. SEMINAR (1 per semester) Reports on current fields of research.
- 508. PHYSIOLOGY OF BACTERIA (2) Composition, nutrition, and growth of microorganisms; influence of physical and chemical environment on metabolism.
- 508a. LABORATORY IN PHYSIOLOGY OF BACTERIA (2) Laboratory work to accompany the lectures given in Bact. 508.
- 509. FERMENTATION (2) Chemical activities of microorganisms; mechanisms of fermentative and oxidative metabolism.
- 510. LABORATORY IN FERMENTATION (2) Laboratory procedures and problems in fermentation to accompany Bact. 509.
- 512. BACTERIOLOGICAL TECHNIQUES (1-6) Practice in special laboratory techniques including manometry, tissue culture, and serology.
- 515. PATHOGENIC BACTERIOLOGY AND VIROLOGY (3-6) Important bacterial, rickettsial, and viral agents parasitizing man and animals; immunological and epidemiological considerations of host response. Prerequisite: Bact. 410.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401. GENERAL MICROBIOLOGY (4)
- 407. BACTERIOLOGY PROBLEMS (2-9)
- 410. IMMUNOLOGY AND SEROLOGY (4)
- 411. BACTERIOLOGICAL SURVEY (1)
- 412. ADVANCED BACTERIOLOGY (4)
- 413. SOIL MICROBIOLOGY (3)
- 414. FOOD MICROBIOLOGY (4)
- 416. INDUSTRIAL MICROBIOLOGY (4)

BOTANY

PROFESSOR HENRY W. POPP, M.S., Ph.D.

Head of the Department

- 500. PLANT PHYSIOLOGY SEMINAR (1 per semester) Selected topics from recent literature; staff and student reports on current research.
Professors Popp and Van Norman
- 501. THE PHYSIOLOGY OF THE FUNGI (3) Chemical composition, metabolism, toxic and stimulating agencies, spore germination, growth and irritability of the fungi. Prerequisites: Bot. 406, 419, and preferably Chem. 32.
Professor Fergus

505. CYTOLOGY AND CYTOGENETICS (3) Cells and their components; nuclear and cell division, meiosis and fertilization; the chromosome mechanism of heredity. Prerequisites: Bot. 22, 421. *Professor Hawthorne*
506. COMPARATIVE ANATOMY OF VASCULAR PLANTS (3) Structure of the Tracheophyta from a phylogenetic standpoint. Prerequisite: Bot. 407. *Professor Kribs*
508. PROBLEMS IN GENETICS (2-6) Problems to suit needs of individual students; conferences and laboratory work. Prerequisite: Bot. 422. *Professor Wright*
509. PHYSIOLOGY OF PATHOGENICITY (3) Physiological processes of plant pathogenic bacteria and fungi occurring during incubation, ingress, and infection. Prerequisite: Bot. 10, 11, or 419.
511. PHYSIOLOGY OF PLANT GROWTH AND DEVELOPMENT (2-4) Prerequisite: Bot. 406. *Professor Popp*
512. PHYSIOLOGY OF PLANT METABOLISM (2-4) Prerequisite: Bot. 406. *Professor Van Norman*
513. WATER AND MINERAL RELATIONS OF PLANTS (2-4) Absorption of water and minerals; transport of materials within the plant; physiology of transpiration. Prerequisite: Bot. 406. *Professor Van Norman*
515. DISEASE RESISTANCE IN PLANTS (2-4) Stability of resistance, selection of resistant material, economics of control, special problems. Prerequisites: Bot. 22 or 32, 10. *Professors Wernham and Mills*
518. BOTANICAL PROBLEMS (1-15 per semester) *Professor Popp and Staff*
519. PLANT VIRUSES (3) Nature, symptomatology, transmission, and control of virus diseases of plants. *Professor Boyle*
520. PLANT PATHOGENIC BACTERIA (3) Bacteria causing plant diseases, methods of identification, inoculation and control. *Professor Kneebone*
521. MOLDS, YEASTS, AND ACTINOMYCETES (3) Morphology and taxonomy of fungi important in microbiology; identification and techniques of study.
522. MYXOMYCETES, PHYCOMYCETES, AND ASCOMYCETES (4) Morphology, taxonomy, phylogeny, and life histories; identification and field work. Prerequisite: Bot. 419. *Professor Fergus*
523. BASIDIOMYCETES AND FUNGI IMPERFECTI (4) Morphology, taxonomy, phylogeny, and life histories. Prerequisite: Bot. 419. *Professor Fergus*
524. SEMINAR IN GENETICS (1 per semester) Review of current research publications in genetics. *Professor Wright*
- 527aS-527bS. PLANT BIOLOGY (3 each) (a) Structure and physiology; (b) reproduction processes, development and relationships of plant groups. Methods of obtaining materials and setting up experiments. Given in alternate years. Prerequisite: general biology or general botany courses.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

406. PLANT PHYSIOLOGY (4) *Professor Van Norman*

BOTANY

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| 407. PLANT ANATOMY (3) | <i>Professor Kribs</i> |
| 408. PLANT PATHOLOGICAL TECHNIQUES (3) | |
| 409. PLANT ECOLOGY (3) | <i>Professor Kovar</i> |
| 412. ADVANCED FOREST PATHOLOGY (3) | <i>Professor Fergus</i> |
| 414, 414X. TAXONOMY OF VASCULAR PLANTS (3) | <i>Professor Wahl</i> |
| 415. MORPHOLOGY OF THE ALGAE (3) | <i>Professor Wahl</i> |
| 416. MORPHOLOGY OF THE BRYOPHYTES (2) | <i>Professor Grove</i> |
| 417. MORPHOLOGY OF THE TRACHEOPHYTES EXCLUSIVE OF ANGIOSPERMS (3) | <i>Professor Grove</i> |
| 418. BOTANICAL PROBLEMS (1-6) | <i>Professor Popp and Staff</i> |
| 419. MYCOLOGY (3) | <i>Professor Fergus</i> |
| 420. MORPHOLOGY OF THE ANGIOSPERMS (3) | <i>Professor Grove</i> |
| 421. BOTANICAL TECHNIQUE (3) | <i>Professor Grove</i> |
| 422. ADVANCED GENETICS (3) | <i>Professor Wright</i> |
| 424. COMMERCIAL TROPICAL WOODS (3) | <i>Professor Kribs</i> |
| 425a, 425b. STRUCTURE OF ECONOMIC PLANTS (3-6) | <i>Professor Grove</i> |
| 426. PHOTOMICROGRAPHY (2) | <i>Professor Kribs</i> |
| 427. ADVANCED SYSTEMATIC BOTANY (1-6) | <i>Professor Wahl</i> |
| 428. ADVANCED PLANT PATHOLOGY (2) | |
| 432S. GENETICS, EUGENICS, AND EVOLUTION (3) | <i>Professor Wright</i> |

BUSINESS STATISTICS

Consult PROFESSOR ROGER B. SAYLOR, A.M., Ph.D.

500. SEMINAR IN BUSINESS STATISTICS (3)
501. ADVANCED BUSINESS STATISTICS (3)

CERAMICS

PROFESSOR EDWARD C. HENRY, M.S., Cer.E., Ph.D.

Chief of the Division

500. CERAMIC SEMINAR (1 per semester) Conferences, reading, and reports. Required of all graduate students in ceramics. Prerequisites: Chem. 41, Phys. 285.
Professor Henry and Staff
501. CERAMIC RESEARCH (1-15 per semester) Laboratory study on special ceramic problems.
Professor Henry and Staff
502. HEAT TREATMENT OF CERAMIC MATERIALS (2-5) Effect of controlled heat treatment on physical and chemical properties of various mineral systems.
503. CONSTITUTION OF GLASS (2-4) Advanced course on glass dealing with latest developments in the structure of viscous liquids and transparent amorphous solids. Prerequisite: Cer. 415.
Professor Weyl
504. RESEARCH INSTRUMENTS AND EQUIPMENT (2) Applications of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations). Prerequisite: Cer. 411.

505. GLASS TECHNOLOGY RESEARCH (1-15 per semester) Laboratory studies on special problems concerning properties, constitution, and manufacture of glass. Prerequisite: Cer. 415. *Professor Weyl and Staff*
506. GLASS TECHNOLOGY SEMINAR (1-6) Group discussion of special advanced topics concerning properties and manufacture of glass. Prerequisite: Cer. 415. *Professor Weyl and Staff*
507. COLORING AND DECOLORIZING GLASS (1) Physical-chemical considerations of various coloring oxides; oxidation-reduction equilibria pertaining to coloring and decolorizing of glass. Prerequisite: Cer. 415. *Professor Weyl*
508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Colloidal activity in bodies, glazes, and enamels, drilling fluids, filtering and bleaching clays, and similar mineral systems. (In co-operation with the Petroleum and Natural Gas staff.) Prerequisite: Chem. 41. *Professor Henry*
509. SILICATE SYSTEMS (3) Properties of silica; classification of silicates; reactions in binary and ternary systems; industrial applications of the phase rule. Prerequisites: Chem. 41, Cer. 303.
510. CERAMIC PROBLEMS (1-6 per semester) Advanced individual study on a problem in some branch of ceramics, including review of the literature and a full report. Prerequisite: Cer. 411. *Professor Henry and Staff*
511. SELECTED TOPICS IN CERAMICS (1-3 per semester) Intensive group study of special subjects, such as diffusion in solids, viscosity, and kinetics of ceramic processes. Prerequisite: Chem. 41, Phys. 285. *Professor Henry and Staff*
512. SYNTHESIS OF CERAMIC COMPOUNDS (3) Advanced ceramic technology applied to the control of phases formed in commercial production of glass, whitewares, refractories, and cements. Prerequisites: Chem. 41, Cer. 303. *Professor Hummel*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. SPECIAL TOPICS (1-2)
401. CERAMIC BODIES AND GLAZES (3) *Professor Hummel*
402. PRINCIPLES OF CERAMIC ENGINEERING (3) *Professor Henry*
403. CERAMIC ENGINEERING PROCESSES AND EQUIPMENT (3) *Professor Ehman*
404. CERAMIC SEMINAR (1) *Professor Henry and Staff*
405. CERAMIC RESEARCH AND DESIGN (3) *Professor Henry and Staff*
411. THEORY OF CERAMIC PROCESSES (2) *Professor Hummel*
- 413, 413X. CERAMIC PETROGRAPHY (3)
415. GLASS AND ENAMELS (3) *Professor Ehman*
416. ADVANCED GLASS TECHNOLOGY (3) *Professors Weyl and Rindone*
420. REFRACTORIES (3)

CHEMICAL ENGINEERING

PROFESSOR DONALD S. CRYDER, M.S., D.Sc.

Head of the Department

500. SEMINAR IN CHEMICAL ENGINEERING (1) Required of all graduate students.

CHEMICAL ENGINEERING

510. ADVANCED HEAT TRANSFER I (3) Physical and chemical factors controlling the rate of heat transfer under conditions of steady flow. *Professor Cryder*
511. ADVANCED HEAT TRANSFER II (3) Flow of heat under varying temperature conditions. *Professor Cryder*
515. DISTILLATION (3) Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns. *Professor Carnahan*
516. ECONOMIC BALANCE (3) Problem work on the design of chemical engineering equipment from the economic standpoint. *Professor Cannon*
518. CHEMICAL ENGINEERING DESIGN (3) Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. *Professor Cryder*
524. CHEMICAL ENGINEERING, APPLICATION OF THERMODYNAMICS (3) Elements of thermochemistry and thermodynamics of greatest importance in chemical engineering. *Professor Cannon*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

402. CHEMICAL ENGINEERING (4) *Professor Carnahan*
403. CHEMICAL ENGINEERING (4) *Professor Carnahan*
422. MOTOR FUELS (2) *Professor Carnahan*

CHEMISTRY

PROFESSOR W. CONARD FERNELIUS, M.A., Ph.D.

Head of the Department

500. SEMINAR IN INORGANIC CHEMISTRY (1)
501. SEMINAR IN PHYSICAL CHEMISTRY (1)
502. SEMINAR IN ORGANIC CHEMISTRY (1)
503. SEMINAR IN ANALYTICAL CHEMISTRY (1)
516. SYSTEMATIC INORGANIC CHEMISTRY (3) Systematic treatment of inorganic chemistry in terms of modern concepts. *Professors Fernelius, Wartik, and Haas*
517. CHEMISTRY OF THE LESS FAMILIAR ELEMENTS (3) Continuation of Chem. 516. *Professors Fernelius, Wartik, and Block*
518. SPECIAL TOPICS IN INORGANIC CHEMISTRY (3 per semester) Modern developments in specialized fields.
525. ANALYTICAL CHEMISTRY (3) Analytical principles as applied to analysis of inorganic and organic substances. *Professor Hayes*
526. ADVANCED ANALYTICAL CHEMISTRY (3) Theory and practice of contemporary analytical chemistry as used in chemical research and plant operation.

527. SPECIAL TOPICS IN ANALYTICAL CHEMISTRY (2-12) Currently used techniques in analytical chemistry.
531. SPECIAL TOPICS IN ORGANIC CHEMISTRY (3) May be taken for credit for four successive semesters.
532. ORGANIC NITROGEN COMPOUNDS (3) Chemistry, stereochemistry, and molecular structure of organic compounds containing nitrogen. *Professor Aston*
534. THEORETICAL ORGANIC CHEMISTRY (3) Modern theories of structure; resonance; interpretation of physical properties; theory of rates; equilibrium properties. *Professor Aston*
- 535-536. ORGANIC CHEMISTRY (3 each) Adapted to the needs of those doing research work in organic chemistry. *Professor Zook*
538. ORGANIC CHEMISTRY (3) Survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry. *Professors Noll and Oakwood*
539. STEREOCHEMISTRY (3) Comprehensive treatment of the principles of stereochemistry as applied to organic compounds. *Professor Oakwood*
541. PHASE RULE (3) The phase rule and its applications. *Professor Currier*
542. COLLOIDS (3) The physics and chemistry of surfaces and their resulting colloid properties. Methods of preparing colloids. *Professor Smith*
543. RHEOLOGY OF COLLOIDS (3) Continuation of Chem. 542. Rheology especially as applied to colloids and similar substances. *Professor Smith*
544. CHEMICAL THERMODYNAMICS (3) Development of thermodynamic theory with special reference to common physical changes and chemical reactions. Prerequisite: Chem. 441 or 562. *Professors Aston and Fritz*
545. CHEMICAL THERMODYNAMICS AND INTRODUCTORY STATISTICAL MECHANICS (3) Continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544. *Professors Aston and Fritz*
546. QUANTUM CHEMISTRY (3) Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with special emphasis on the portion of the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Given alternate years only. *Professor Aston*
547. STATISTICAL MECHANICS (3) Properties of matter at equilibrium, developed on the basis of energy levels of molecules and statistical mechanical theory. Prerequisite: Chem. 546. Given alternate years only. *Professor Aston*
548. CATALYSIS (3) Theory of catalysis and its application to industry. *Professor Currier*
- 561-562. CHEMICAL PRINCIPLES (3 each) Mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 41, Math. 11, Phys. 285. A course in organic chemistry is recommended. *Professors Seward, Fritz, Ascah, and Taft*

CHEMISTRY

563. CHEMICAL KINETICS (3) Theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions. *Professors Ascah and Taft*
564. CHEMICAL KINETICS (3) Continuation of Chem. 563 but including theory and measurement of photochemical reactions. *Professors Ascah and Taft*
- 565-566. ATOMIC AND MOLECULAR STRUCTURE (3 each) Structure of chemical species and correlation of experimentally determined properties by structural theory.
- 567-568. ADVANCED THEORETICAL CHEMISTRY (3 each) Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. CHEMICAL LITERATURE (1) *Miss Jackson*
- 411-412. FLUORINE CHEMISTRY (3 each)
413. INORGANIC PREPARATIONS AND LABORATORY METHODS (2-5) *Professor Block*
426. ADVANCED QUALITATIVE AND QUANTITATIVE ANALYSIS (3-5) Breakage ticket \$10. *Professor Hayes*
434. QUANTITATIVE ORGANIC ANALYSIS (3-5) Breakage ticket \$10 for 3 credits, \$12 for 4 or 5 credits.
435. ORGANIC PREPARATIONS AND LABORATORY METHODS (3-5) Breakage ticket \$10 for 3 credits, \$12 for 4 or 5 credits. *Professor Oakwood*
436. ORGANIC CHEMISTRY OF NATURAL PRODUCTS (3) *Professor Aston*
437. QUALITATIVE ORGANIC ANALYSIS (3) Breakage ticket \$4. *Professors Olewine and Noll*
- 440-441. ADVANCED PHYSICAL CHEMISTRY (3 each) *Professors Hutchison and Seward*
448. COLLOID CHEMISTRY (3) Breakage ticket \$3. *Professor Hutchison*
470. CHEMICAL MICROSCOPY (3) Breakage ticket \$2. *Professor Willard*
471. ADVANCED CHEMICAL MICROSCOPY (3) Breakage ticket \$2. *Professor Willard*
472. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$2. *Professor Fleming*
473. TEXTILE MICROSCOPY (3) Breakage ticket \$2. *Professor Willard*
474. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$2. *Professor Fleming*
475. INTRODUCTION TO CHEMICAL SPECTROSCOPY (3) Breakage ticket \$2. *Professor Schempf*
476. MICROSCOPIC MICROTECHNIQUE (3) Breakage ticket \$2. *Professor Willard*
477. CHEMICAL PHOTOMICROGRAPHY (3) Breakage ticket \$2. *Professor Willard*
489. INTRODUCTION TO CHEMICAL RESEARCH (3-5)
- 489X. INTRODUCTION TO CHEMICAL RESEARCH (2)
- *490. ORGANIC CHEMISTRY (5) Breakage ticket \$4. *Professor Olewine*
- *491. ORGANIC CHEMISTRY (5) Breakage ticket \$12. *Professor Olewine*
- *492a. ADVANCED GENERAL CHEMISTRY (3) Breakage ticket \$3. *Professor Currier*
- *496. GENERAL PHYSICAL CHEMISTRY (3) *Professor Seward*
- *497. GENERAL PHYSICAL CHEMISTRY (3) *Professor Seward*
- *498. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket \$6. *Professor Ascah*
- *499. PHYSICOCHEMICAL MEASUREMENTS (1) Breakage ticket \$6. *Professor Ascah*

* Candidates for the M.Ed. degree

CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS

PROFESSOR WINONA L. MORGAN, M.A., Ph.D.

Head of the Department

508. PARENTAL EDUCATION (3) Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: Ch.Fm. 429, 430. *Professor Morgan*
- 515, 515X. THE TEACHING OF CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (3) Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for Ch.Fm. 482. Prerequisite: 6 credits in child development and family relationships. *Professor Morgan*
529. (Psy. 529). SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisites: Ch.Fm. 429, 430, or Psy. 411, or 425. *Professor Morgan*
536. CHILDREN IN POSTWAR FAMILIES AND COMMUNITIES (3) Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: Ch.Fm. 429, 430, or 2 courses in psychology. *Professor Morgan*
- 545, 545X. THE FAMILY IN ITS COMMUNITY (2-3) Cultural influences on family relationships; how the family orients its members to community living and group participation. Prerequisites: Soc. 1, Ch.Fm. 405; R.Soc. 452 or Psy. 419. *Professor Smith*
546. SEMINAR IN FAMILY RELATIONSHIPS (1-3) Reading, reports, and discussion of recent research in relationship aspects of family living; particular attention to studies of roles, crises, and adjustments within the family setting. Prerequisite: Ch.Fm. 405 or 6 hours of sociology or psychology. *Professor Smith*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

405. MARRIAGE AND FAMILY RELATIONSHIPS (3) *Professor Smith*
429, 429X. CHILD DEVELOPMENT (3) *Professor Avery*
430. OBSERVATION AND EXPERIENCE IN NURSERY SCHOOL (1-4)
440, 440X. STUDY OF LATER CHILDHOOD (3) *Professor Avery*
441. NURSERY SCHOOL ORGANIZATION (3) *Professor Morgan*
445. (Psy. 445). DEVELOPMENT THROUGHOUT ADULTHOOD (3) *Professor Britton*
481. EDUCATIONAL METHODS WITH PRESCHOOL CHILDREN (3) *Professor Bowie*
482. EDUCATIONAL PROCEDURES IN CHILD DEVELOPMENT AND FAMILY RELATIONS (3) *Professor Morgan*
495S. (Ed. 495S, Hl.Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)

CIVIL ENGINEERING

PROFESSOR BENJAMIN A. WHISLER, M.S., Sc.D.

Head of the Department

500. SEMINAR IN CIVIL ENGINEERING (1-6) Reports on researches and special topics. Course may be continued in subsequent semesters.
521. TRANSPORT PLANNING AND DESIGN (2-6) Planning and design of transportation facilities; basic principles and engineering techniques applied to airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.
522. TRANSPORT OPERATION AND MAINTENANCE (2-6) Engineering problems in operation, maintenance, and administration of airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.
540. ADVANCED STRUCTURAL ANALYSIS (2-4) Geometry of flexure; deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C.E. 40.
541. ADVANCED STRUCTURAL ANALYSIS (2-4) Truss deflection; trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C.E. 40.
542. APPLIED SOIL MECHANICS (2-5) Soil classification by type of clay minerals and profile development; aerial photographic interpretation of soils and applications to site selection for dams, highways, and airports. Prerequisites: C.E. 412, 444, Geol. 71.
543. STRUCTURAL ENGINEERING PROJECTS (3-10) Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C.E. 441, 442.
544. ADVANCED STRUCTURAL DESIGN (2-4) Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisites: C.E. 42, 442.
545. ADVANCED STRUCTURAL DESIGN (2-4) Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C.E. 41.
550. ENGINEERING CONSTRUCTION (2-4) Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C.E. 41, 42.
551. HYDROLOGIC INVESTIGATIONS (2-8) Application of hydrologic principles and techniques to a specific project. Prerequisite: C.E. 451.
560. HYDRAULIC STRUCTURES (3) Hydraulic and structural considerations in design of dams, spillways, gates, canals and flumes, siphons, and locks. Prerequisite: C.E. 462.
562. ADVANCED FLUID MECHANICS (3) Euler's equations, potential theory, flow nets, conformal mapping, boundary layers, turbulence, compressibility, wave theory, flow of viscous fluids.

CIVIL ENGINEERING

566. FLUID MECHANICS OF HYDRAULIC MACHINERY (3) Advanced theory and design of hydraulic machinery. Prerequisite: C.E. 466.
568. THEORETICAL HYDRODYNAMICS (3) Analysis of the irrotational motion of fluids in two and three dimensions, vortex motion, wave theory, theory of viscous fluids.
570. RURAL SANITATION DESIGN (3) Requirements and devices essential to rural sanitary problems: water supply, excreta disposal, industrial waste treatment. Not intended for civil or sanitary engineering students. Prerequisites: Chem. 4, Phys. 285.
571. WATER PURIFICATION AND SOFTENING (3) Current methods of softening, disinfecting, and conditioning water for municipal and industrial use. Prerequisite: C.E. 70.
572. SEWAGE TREATMENT (3) Modern methods of sewage treatment. Prerequisite: C.E. 70.
573. ADVANCED PROBLEMS IN SANITARY ENGINEERING (3-10) Continuation of C.E. 474 on a graduate level. Prerequisite: C.E. 474.
575. ADVANCED INDUSTRIAL WASTE TREATMENT (3) Techniques of industrial waste treatment; attendant stream pollution and stream self-purification factors. Prerequisite: C.E. 472 or 572.
576. WATER TREATMENT PLANT DESIGN (1-6) Design of works for treatment of water for municipal and industrial use. Prerequisite: C.E. 71.
577. SEWAGE TREATMENT PLANT DESIGN (1-6) Design of works for treatment of sewage or industrial wastes. Prerequisite: C.E. 71.
578. INDUSTRIAL HYGIENE (3) Principles of control of industrial toxics and the protection of the worker and the community.
579. PUBLIC HEALTH ADMINISTRATION (3) Operation and duties of health departments at the various levels.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401a,b,c,d. CIVIL ENGINEERING PROJECTS (2-12)
412. ADVANCED PHOTOGRAMMETRY (3)
421. HIGHWAYS AND STREETS (3)
422. RAILROADS (3)
423. HIGHWAY SAFETY AND TRAFFIC CONTROL (3)
431. CIVIL ENGINEERING CONSTRUCTION (3)
441. STATICALLY INDETERMINATE STRUCTURES (3)
- 442, 442X. STATICALLY INDETERMINATE STRUCTURES (3)
443. PHOTOELASTICITY AND MODEL ANALYSIS (3)
- 444, 444X. SOIL MECHANICS AND FOUNDATIONS (3)
446. ADVANCED SOIL MECHANICS (3)
451. ADVANCED HYDROLOGY (3)
462. ADVANCED HYDRAULICS (3)
463. HYDRAULIC LABORATORY INVESTIGATIONS (1-6)
465. APPLIED HYDRAULICS (3)

CIVIL ENGINEERING

- 466. HYDRAULIC MACHINERY (3)
- 471. MUNICIPAL AND RURAL SANITATION (3)
- 472. SEWAGE AND INDUSTRIAL WASTES TREATMENT (3)
- 473. WATER AND SEWAGE ANALYSIS (3)
- 474. SANITARY ENGINEERING PROBLEMS (1-6)
- 475. WATER TREATMENT AND CONDITIONING (3)
- 481. MUNICIPAL PLANNING AND ZONING (3)

CLOTHING AND TEXTILES

PROFESSOR RUTH W. AYRES, A.M., Ph.D.

Head of the Department

- 502. TAILORING (3) Construction of tailored garments for women and children from new or renovated materials. Prerequisites: Cl.Tex. 102, 201.
- 503. ADVANCED FITTING AND PATTERN STUDY (3) Application of principles involved in altering patterns and fitting garments to give students freedom in designing and ability to deal with difficult fitting problems. Prerequisite: Cl.Tex. 201.
- 504. ADVANCED DRESS DESIGN (3) Draping of garments difficult in type and distinctive in design; survey of literature in dress design. Prerequisites: Art 56, Cl.Tex. 404.
- 505, 505X. CLOTHING INSTRUCTIONAL MATERIALS (3) Preparation and evaluation of different types of materials for instruction in textiles and clothing. Prerequisite: Cl.Tex. 201.
- 506. THE FASHION WORLD (3) Development of fashion throughout the ages; relationship of present-day fashions and practices with previous periods. Prerequisites: Cl.Tex. 102, 301.
- 507. PROBLEMS IN RELATION TO CLOTHING CONSUMPTION (3) Problems connected with manufacture and consumption of clothing, interrelation of textile and clothing trades with other industries. Prerequisite: Cl.Tex. 301.
- 508. SPECIAL PROBLEMS IN CLOTHING AND TEXTILES (1-6) Individual directed study, investigation, and practice in selected phases of textiles and clothing. Prerequisites: Cl.Tex. 102, 201.
- 509, 509X. SEMINAR IN CLOTHING AND TEXTILES (1-6) Discussion and reports on current research in clothing and textiles.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401. CLOTHING CONSERVATION (2-3)
- 403. FITTING AND PATTERN ADJUSTMENT (3)
- 404. DRESS DESIGN (3)
- 405, 405X. FASHION MERCHANDISING (3)
- 406. FASHION PROMOTION OF TEXTILES AND CLOTHING (3)
- 407. THE TEXTILE AND CLOTHING INDUSTRY (3)
- 408. TEXTILES (3)
- 409, 409X. COSTUME SELECTION (3)

COMMERCE

PROFESSOR RALPH H. WHERRY, M.A., C.L.U.

Acting Head of the Department

500. CASE STUDIES IN BUSINESS ADMINISTRATION (3) Case studies of business and management policy with respect to procurement, production, selling, finance, accounting, relations with government, labor, and the public. *Professor Waters*
501. COMMERCE SEMINAR (3-6) Reports on research in selected fields of commercial activities.
502. SEMINAR IN BUSINESS MANAGEMENT (3) *Professor Waters*
503. TRANSPORTATION AND PUBLIC UTILITY SEMINAR (3) *Professor Waters*
506. SEMINAR IN INVESTMENTS AND CORPORATION FINANCE (3)
515. TRANSPORTATION RATES AND BUSINESS (3) Rate making and rate changes and their effects on business location and development. Prerequisite: Com. 15. *Professor Waters*
517. INTERNATIONAL BUSINESS PRACTICES (3) Practices of exporters and importers dealing in commodities traded in world markets under competition, monopoly, or governmental control. Prerequisite: Com. 17. *Professor Hensch*
523. SEMINAR IN MARKETING (3-6) Research in modern marketing trends. *Professor Hilgert*
525. CASE STUDIES IN INSURANCE (3) Analysis of management's insurance problems, such as the feasibility of self-insurance; proper allocation of insurance premiums and coverage in selected industries, etc. Prerequisites: Com. 25, 33. *Professor Wherry*
526. ADVERTISING SEMINAR (3) Advertising budgeting, selection of media, appraisal of effectiveness, co-ordination of advertising and selling efforts. Prerequisite: Com. 23. *Professor Hilgert*
529. SEMINAR IN RETAILING (3) *Professor Einstein*
536. SALES MANAGEMENT SEMINAR (3) Principles of sales planning and administration; co-ordination of selling with advertising, promotion, production, and accounting; use of market research selling costs and budgets. Prerequisite: Econ. 1. *Professor Hilgert*
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
401. INDUSTRIAL PURCHASING (3) *Professor Babione*
405. ANALYSIS OF FINANCIAL STATEMENTS (3) *Professor Bradley*
406. INVESTMENT ANALYSIS (3) *Professor Malott*
407. INVESTMENT BANKING (3) *Professor Bradley*
410. BANK MANAGEMENT (3) *Professor McKinley*
415. REGULATION OF TRANSPORT CARRIERS (3) *Professor Waters*
417. FOREIGN MARKETS (3) *Professor Reedy*
422. SALES PROMOTION (3) *Professor Decker*
424. MARKETING RESEARCH (3) *Professor Hilgert*

COMMERCE

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| 425. INSURANCE AGENCY MANAGEMENT (3) | <i>Professor Wherry</i> |
| 426. STORE MANAGEMENT AND OPERATION (3) | <i>Professor Einstein</i> |
| 427. RETAIL BUYING AND MERCHANDISING (3) | <i>Professor Einstein</i> |
| 428. RETAIL ADVERTISING AND SALES PROMOTION (3) | <i>Professor Einstein</i> |
| 430. ADVANCED BUSINESS LAW (3) | <i>Professor Phalan</i> |
| 436. FUNDAMENTALS OF SALES MANAGEMENT (3) | <i>Professor Hilgert</i> |
| 461. CASE STUDIES IN AMERICAN INDUSTRIES (3) | <i>Professor Mares</i> |
| 470. PUBLIC RELATIONS IN BUSINESS (3) | <i>Professor Wherry</i> |
| 476. ADVANCED BUSINESS MANAGEMENT (3) | |

COMMERCIAL CONSUMER SERVICES

PROFESSOR MARY BROWN ALLGOOD, M.S.

Chairman of the Division

The following courses may be taken for graduate credit under the restrictions in force:

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| 403. LECTURE-DEMONSTRATION TECHNIQUES (3) | <i>Professor Allgood</i> |
| 450. PROBLEMS IN HOUSEHOLD EQUIPMENT (1-6) | <i>Professor Allgood</i> |

COMPARATIVE LITERATURE

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.

Chairman of the Committee in Charge

500. SEMINAR IN COMPARATIVE LITERATURE (3-6)

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

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| 400. COMPARATIVE METHOD IN LITERARY STUDIES (3) | |
| 480. INTRODUCTION TO FOLKLORE (3) | <i>Professor Bayard</i> |

DAIRY HUSBANDRY

PROFESSOR DONALD V. JOSEPHSON, M.S., Ph.D.

Head of the Department

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| 501. BUTTER AND CHEESE (1-6) | Manufacture and handling of butter and cheese. | |
| Prerequisites: D.H. 10, 23, Bact. 8, A.B.Ch. 403. | | <i>Professor Dahle</i> |
| 502. CONDENSED MILK AND MILK POWDER (1-6) | Condensing and drying of milk. | |
| Prerequisites: D.H. 10, 26, Bact. 8, A.B.Ch. 403. | | <i>Professor Doan</i> |
| 503. PUBLIC MILK PROBLEMS (1-6) | Handling milk in modern plants. | |
| Prerequisites: D.H. 11, Bact. 8, A.B.Ch. 403. | | <i>Professor Doan</i> |

DAIRY HUSBANDRY

504. ICE CREAM MANUFACTURE (1-6) Manufacture of ice cream, ices, and other frozen milk products. Prerequisites: D.H. 11, Bact. 8, A.B.Ch. 403.
Professor Dahle
505. DAIRY PLANT ECONOMICS (1-6) Economic factors involved in creamery operation and management. Prerequisites: D.H. 7, 11.
Professor Dahle
506. DAIRY CATTLE BREEDING (1-6) Improvement of dairy cattle, including methods of sire evaluation, systems of breeding, and development of breeding programs. Prerequisite: D.H. 30.
Professor Almquist
507. DAIRY CATTLE MANAGEMENT (1-6) Management of dairy cattle. Prerequisite: D.H. 27.
Professor Williams and Staff
508. DAIRY SEMINAR (1-6) Preparation and presentation of a paper on an assigned subject.
Professor Josephson and Staff
509. TESTING DAIRY PRODUCTS (1-6) Constituents of dairy products. Prerequisites: D.H. 11, Bact. 8, A.B.Ch. 403.
Professor Doan
510. DAIRY CATTLE FEEDING (1-6) Application of fundamental research in animal nutrition to the feeding of dairy cattle. Prerequisites: D.H. 1, 29.
Professor Williams
511. DAIRY CATTLE NUTRITION (1-6) Nutritional requirements of dairy cattle. Prerequisites: A.Ntr. 401, 402.
Professor Knodt and Staff
512. ADVANCED STUDIES IN MILK SECRETION (1-6) Physiology of milk secretion. Prerequisite: D.H. 427.
Professor Knodt
513. DAIRY CATTLE SELECTION (1-6) Breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.H. 1, 30.
Professor Knodt and Staff
515. ADVANCED PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (1-6) Reproduction of farm animals.
Professor Almquist
516. ARTIFICIAL BREEDING OF FARM ANIMALS (1-6) Prerequisite: D.H. 431.
Professor Almquist
517. DAIRY HUSBANDRY LITERATURE (1-6) Review and reporting of dairy literature.
Professor Josephson and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

418. DAIRY SURVEY (1) *Professor Josephson*
421. DAIRY MANUFACTURING PROBLEMS (1-6) *Professors Dahle, Doan, and Staff*
427. MILK SECRETION (3) *Professor Knodt*
428. DAIRY PRODUCTION PROBLEMS (1-3)
430. TECHNICAL CONTROL OF DAIRY PRODUCTS (4) *Professor Watrous*
431. PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (3) *Professor Almquist*

DRAMATICS

Consult PROFESSOR ARTHUR C. CLOETINGH, M.A.

- 501. PROBLEMS OF DIRECTING (3-6) Seminar in problems of production with particular stress on direction. Students will direct plays under staff supervision.
- 502. SEMINAR IN THE TECHNICAL PROBLEMS OF DRAMATIC PRODUCTION (3-6) Prerequisite: Dram. 11.
- 504. SEMINAR IN STYLES OF ACTING (3-6) Practical work required of each student.
- 506. EVALUATION AND APPRECIATION OF MODERN DRAMATIC ENTERTAINMENT (3) Prerequisites: Dram. 1, 61.
- 507. SEMINAR IN FUNDAMENTAL THEORIES OF THEATER AND DRAMA (3-6)
- 521. PLAYWRITING (3-6) Prerequisites: Dram. 21, 421.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 403. ADVANCED MAKE-UP (1)
- 404. STYLES OF ACTING (3)
- 412. ADVANCED SCENE DESIGN (3)
- 413. ADVANCED STAGE LIGHTING (3)
- 421. ADVANCED PLAYWRITING (3)
- 431. HISTORY OF THE THEATER (3)
- 442S. EDUCATIONAL DRAMATICS (3)
- 443S. EDUCATIONAL DRAMATICS (ADVANCED MARIONETTES) (3)
- 451. DIRECTING (3)
- 452. CENTRAL STAGING (3)
- 480. RADIO DRAMA (3)
- 481. ADVANCED RADIO DRAMA (3)

ECONOMICS

PROFESSOR HOWARD A. CUTLER, M.A., Ph.D.

Head of the Department

- 500. ECONOMICS SEMINAR (3-6)
- 501. RESEARCH METHODS IN ECONOMICS (3-6)
- 507. SEMINAR IN INTERNATIONAL ECONOMICS: THEORY AND POLICY (3-6)
- 508. SEMINAR IN MONEY, CREDIT, AND PUBLIC FINANCE (3-6) Prerequisite: Econ. 51.
- 510. DEMAND ANALYSIS (3) *Professor Mendelson*
- 511. SEMINAR IN INDUSTRIAL DISPUTES (3) Prerequisites: Econ. 1 or 14; 15. *Professor Myers*
- 515. LABOR SEMINAR (3) *Professor Reede*

522. ADVANCED ECONOMIC THEORY (3-6) Theory of price and income determination. Prerequisite: Econ. 405. *Professor Mendelson*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 400. HISTORY OF ECONOMIC THOUGHT (3) | <i>Professor Liebhafsky</i> |
| 401. RECENT ECONOMIC THOUGHT (3) | <i>Professor Liebhafsky</i> |
| 405. INTERMEDIATE ECONOMIC THEORY (3) | <i>Professor Fouraker</i> |
| 412. ECONOMICS OF COLLECTIVE BARGAINING (3) | <i>Professor Myers</i> |
| 415. SOCIAL INSURANCE (3) | |
| 418. ECONOMICS OF WAGES AND EMPLOYMENT (3) | <i>Professor Belfer</i> |
| 419. CASE STUDIES IN LABOR-MANAGEMENT RELATIONS (3) | <i>Professor Reede</i> |
| 423. PENNSYLVANIA LOCAL AND STATE FINANCE (3) | <i>Professor Stout</i> |
| 425. THE MONEY MARKET (3) | <i>Professor McKinley</i> |
| 426. FISCAL POLICY (3) | <i>Professor Levin</i> |
| 427. MONETARY THEORY AND POLICY (3) | <i>Professor Levin</i> |
| 430. NATIONAL PLANNING (3) | |
| 431. HOUSING AND COMMUNITY DEVELOPMENT (3) | |
| 433. INTERNATIONAL MONETARY ECONOMICS (3) | <i>Professor Reedy</i> |
| 434. INTERNATIONAL TRADE AND PUBLIC POLICY (3) | <i>Professor Reedy</i> |
| 442. STRUCTURE OF THE ECONOMY AND PUBLIC POLICY (3) | <i>Professor Proctor</i> |
| 450. THE BUSINESS CYCLE (3) | <i>Professor Proctor</i> |
| 480. MATHEMATICAL ECONOMICS (3) | <i>Professor Mendelson</i> |
| 490. MEASUREMENT OF THE ECONOMY (3) | <i>Professor Saylor</i> |
| 499X. FOREIGN STUDY IN ECONOMICS (2-6) | |

EDUCATION

PROFESSOR CHARLES M. LONG, M.A., D.Ed.

Head of the Department

501. INTRODUCTION TO THE ADVANCED STUDY OF EDUCATION (1-3) Methods of educational research; criticism of studies and theses in education; initiating research projects; summarizing results of research. Prerequisite: Ed. 470 or Psy. 415. *Professor Davison*
502. SUPERVISED EXPERIENCE IN STUDENT COUNSELING (3) Practice in the application of guidance principles and methods to cases counseled under supervision; case conferences; seminar in guidance techniques. Prerequisite: Ed. 453. *Professor Wellington*
503. SUPERVISION OF GUIDANCE WORKERS (3) Practical experience in supervising and evaluating work of counselors. Prerequisite: Ed. 502. *Professor Wellington*
504. ORGANIZATION AND ADMINISTRATION OF GUIDANCE PROGRAMS (3) Principles, organization, personnel, functions, integration with school program, evaluation. *Professor Wellington*
505. OCCUPATIONAL AND EDUCATIONAL INFORMATION (3) Occupational information for guidance purposes, educational information related to vocational choice and preparation. Prerequisite: Ed. 453. *Professor Wellington*

EDUCATION

506. **DEVELOPING ANALYSES OF THE INDIVIDUAL FOR VOCATIONAL COUNSELING (3)** Collection and use of data basic to the counselor's understanding of individuals; the counseling interview and techniques other than testing. *Professor Wellington*
510. **INTERNSHIP IN PROFESSIONAL EDUCATION (1-9)** Internship to take place in schools or educational situations where not regularly employed under supervision of graduate faculty.
- Unit A. Administration and Supervision (1-6)*
Unit B. College Teaching (3-6)
Unit C. Public School Research (3-6)
Unit D. Elementary Teaching (3-6)
Unit E. Secondary Teaching (3-6)
Unit F. Art Teaching and Supervision (3-6)
Unit G. Business Education Supervision (3-6)
Unit H. Special Education Supervision (3-6)
Unit I. Audio-Visual Education (3-6)
515. **COMPARATIVE EUROPEAN EDUCATION (3)** Educational policies and practices in school systems in western and central European nations. Prerequisite: Psy. 14. *Professors Chiappetta and Russell*
516. **SOCIAL FOUNDATIONS OF THE CURRICULUM (2-4)** Analysis of societal needs as a basis for educational programs; contributions of public education to social advancement. Prerequisites: Ed. 25, Psy. 14. *Professor McNerney*
517. **EVOLUTION OF EDUCATIONAL THOUGHT (2-3)** Rise of formal educational philosophy from Plato to John Dewey; preliminary reference to Chinese, Hindu, Chaldean, Persian, Hebrew, and Egyptian theories.
523. **LABORATORY IN ORGANIZATIONAL ASPECTS OF MATERIALS OF INSTRUCTION (1-3)** Organizing, storing, circulating, and maintaining instructional materials in an instructional materials library. Prerequisites: Ed. 424, 585. Conference 1 hour, alternate weeks by appointment. *Professor VanderMeer*
524. **SEMINAR IN CURRICULUM MATERIALS AND THEIR UTILIZATION (3)** Advanced detailed analysis of mass communication media; relationships among these and educational objectives, individual differences in learners, and ideas to be communicated. Prerequisites: Ed. 424, 585, 6 credits in educational psychology. *Professor VanderMeer*
525. **MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)** Study of science supporting dynamic instruction; principles of teaching as guides; analysis of modern procedures; understanding of learning; substance versus plans. Prerequisite: 12 semester hours of undergraduate work in education. *Professors Butler and Russell*
527. **PROBLEMS IN THE EDUCATION OF THE MENTALLY RETARDED (1-4)** Study of existing curriculums, instructional practices, educational programs; experimentation in curriculum building and materials construction. Prerequisites: Ed. 426 or 583, Unit P, and Ed. 427 and teaching experience. *Professor Neuber*
529. **PROBLEMS IN THE EDUCATION OF THE MENTALLY GIFTED (1-4)** Analysis of educational needs of mentally gifted; curriculum construction and curricular materials. Prerequisites: teaching experience and Ed. 426 or 583, Unit P, and 429. *Professor Neuber*

532. SUPERVISION OF STUDENT TEACHERS (3) A course in supervision for master teachers, department heads, and college teachers with supervisory responsibilities in teacher education. Prerequisite: experience in teaching and 18 credits in education, including at least 5 in methods. *Professor Moyer*

534a. READING CLINIC PRACTICE: ANALYSIS OF READING DISABILITIES (1-9) A laboratory course consisting of analysis of extreme reading disabilities and recommended remedial procedure; experience in preparation of case reports. Prerequisite: Ed. 432g or Psy. 550. *Professor Hunt*

534b. READING CLINIC PRACTICE: REMEDIAL PROCEDURES (1-9) Practicum in special classes for reading disabilities; corrective and remedial procedures; specific procedures for correction of various types of reading disabilities. Prerequisite: Ed. 432g or 534a. *Professor Hunt*

535. SEMINAR ON READING INSTRUCTION (2-12) Designed to appraise significant researches and to outline procedures and materials for research; reading readiness, word perception, basic reading skills, vocabulary development. Prerequisite: Ed. 432b or 432c. *Professor G. E. Murphy*

536. READING CLINIC RESEARCH (1-15) Prerequisites: Ed. 432b; or Ed. 432c, 432g. *Professor G. E. Murphy*

540. PROBLEMS OF ELEMENTARY EDUCATION (2-3) Problems seminar for experienced educators. Prerequisite: 12 credits in education and psychology, including 6 in elementary education.

541. SEMINAR IN CONTEMPORARY ISSUES IN ELEMENTARY EDUCATION (1-3) Conferences and discussions designed to meet the needs of experienced teachers and principals in the field of elementary education. Prerequisite: 6 credits in elementary education and teaching experience.

546. ELEMENTARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3)

548. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3) Principles underlying curriculum construction. Primarily for elementary education majors. Prerequisite: Ed. 31 or teaching experience.

550. PROBLEMS IN MODERN SECONDARY EDUCATION (1-4) Historical, psychological, social, and economic factors influencing secondary education; required as basic course of all graduate students in secondary education. Prerequisite: secondary school teaching. *Professor Butler*

551. SEMINAR IN CONTEMPORARY ISSUES IN SECONDARY EDUCATION (2-9) *Professor McNerney*

Unit A. The Secondary School Curriculum (2-3) Principles and philosophy of curriculum construction. Each student works out an individual problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience.

Unit B. Laboratory Studies in Application of Educational Method (2-3) Analysis and application of outstanding studies in secondary education; integration of results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.

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Unit C. Organization and Administration of Secondary Education (2-3) Problems in reorganization of secondary education, with particular reference to philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology, and teaching experience.

556. THE SECONDARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3) Improvement of instruction; improvement of teachers in service; evaluation of teaching procedures; methods of supervision; selection and use of textbooks. Prerequisite: three years' teaching experience.
561. THE COMMUNITY COLLEGE AND POST-SECONDARY SCHOOL EDUCATION (2-3) Philosophy, organization, and character of school programs needed to meet educational needs of individuals who desire to continue their education on the post-secondary school level. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. *Professors Patrick and Ehmann*
562. THE INSTRUCTIONAL PROGRAM IN COMMUNITY COLLEGES AND POST-SECONDARY EDUCATION (2-3) Course offerings, curriculums, instructional materials and procedures, guidance, extracurricular activities, student personnel, evaluation of results, and faculty qualifications. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. *Professors Patrick and Ehmann*
563. THE PROFESSIONAL EDUCATION OF TEACHERS (3) Development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff. Prerequisite: 6 credits in advanced courses in education and a course in educational psychology.
564. RECENT TRENDS IN HIGHER EDUCATION (2-3) Factors affecting current college enrollment, organization, administration, support, and curriculums, with special emphasis on general education, its development, aims, and forms. *Professor Ehmann*
565. THE PRINCIPLES OF COLLEGE TEACHING (2-3) Principles involved in teaching at the college level; effective use of teaching aids; criteria used in evaluation. *Professor Ehmann*
566. STUDENT PERSONNEL PROGRAMS AT THE COLLEGE LEVEL (2-3) Student personnel services in higher education; organization of student advisory programs; use of personnel data; co-curricular activities; student welfare. *Professor Wellington*
567. GROWTH AND ORGANIZATION OF HIGHER EDUCATION (2-3) Growth of higher education; influence of church, state, federal government; educational, social, and economic factors that have affected curriculums and organization of institutions. *Professor Ehmann*
568. CURRICULUMS IN HIGHER EDUCATION (2-3) Various types of curriculums and philosophies underlying them; ways in which curriculums are developed; elective versus required courses; evaluation of achievement. *Professor Ehmann*
569. SEMINAR IN COLLEGIATE EDUCATION (1-6) Special topics in higher education. Prerequisite: Ed. 567. *Professor Weaver*
574. ADVANCED EDUCATIONAL STATISTICS (2-4) Appropriate measures and devices for experimental research in education including correlation measures, curve fitting, and analysis of variance. Prerequisite: 12 credits of graduate work in education including Ed. 470 or Psy. 415. *Professor Davison*

575. ADMINISTRATION AND SUPERVISION IN BUSINESS EDUCATION (3) Work of administrators, supervisors, and others responsible for improvement of instruction in business education; use of vocational testing; job analysis. Prerequisite: 6 credits in secondary education. *Professors Gemmell and Veon*

576. INTRODUCTION TO RESEARCH IN BUSINESS EDUCATION (3) Methods of research in business education; opportunity to compile annotated bibliographies on current problems; analysis and evaluation of significant research. *Professor Gemmell*

577. EVALUATION OF RESEARCH AND EMPIRICAL LITERATURE IN BUSINESS EDUCATION (3) Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576. *Professor Gemmell*

578. SEMINAR IN BUSINESS EDUCATION (3) Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577. *Professor Gemmell*

580. SEMINAR IN SCHOOL ADMINISTRATION (1-6) Efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, stimulating co-operative work. Prerequisite: Ed. 480, 6 credits of Ed. 583. *Professor Aurand*

582. EDUCATIONAL SURVEY TECHNIQUES (2-3) Methods for appraisal of an educational program; planning for expansion, consolidation, or reduction of educational offerings. Prerequisites: Ed. 480, 6 credits of Ed. 583. *Professor Aurand*

583, 583X. PROBLEMS IN ADMINISTRATION AND SUPERVISION (2-25) Prerequisite: Ed. 480 or teaching or administrative or supervisory experience. *Professor Aurand and Staff*

Unit A. *The Educational Plant* (2-3)

Unit B. *Public Relations for School Administrators* (2-3)

Unit C. *Public School Finance* (2-3)

Unit F. *State and National Education Programs* (2-3)

Unit I. *Administration of Adult Education in the Public Schools* (3)

Unit M. *Legal Aspects of School Administration* (3)

Unit P. *The Administration of Public School Education for Atypical Children* (2)

Unit Q. *Dynamic Factors in School Administration* (2-3)

Unit R. *Public School Business Administration* (2-3)

585. CURRICULUM CONSTRUCTION (2-3) Functions of administrators, supervisors, teachers, pupils, and laymen in curriculum building to meet pupil and community needs. *Professor McGarey*

586. PRINCIPLES OF SCHOOL SUPERVISION (2-3) Organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests and teacher rating. Prerequisite: 18 credits in education and 3 years' teaching experience. *Professor McNerney*

587. THE SECONDARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-4) Problems of schedule making, teachers' meetings, curriculum making and revision, organization of extracurricular and guidance programs. Prerequisite: teaching experience.

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589. THE ELEMENTARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-3) Duties of the elementary school principal in organizing and administering his school. Prerequisite: Ed. 442.
590. PHILOSOPHY OF EDUCATION (2-4) Fundamental principles; scientific sanctions of progressive instructional practices and professional experiences as bases for formulation of the educational creed. Prerequisite: 18 credits in education.
Professor Chiappetta
591. EDUCATION IN RUSSIA, ASIA, AND THE MIDDLE EAST (2-3) Current educational activities in Soviet Russia and other eastern European countries; the Middle East, North Africa, and the Far East.
Professor Chiappetta
592. EDUCATION IN THE LATIN-AMERICAN COUNTRIES (2-3) Recent educational progress in Central and South America, with special reference to Mexico, Cuba, Puerto Rico, Brazil, Chile, and Argentina.
594. SEMINAR IN EDUCATION (1-3) Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: 12 credits of graduate work in education.
Professors Long and Davison
- 597S. WORKSHOP IN CURRENT EDUCATIONAL PROBLEMS (1-6) For administrators, supervisors, experienced elementary and secondary teachers, guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Prerequisite: 12 credits of graduate work in education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 413, 413X. HISTORY OF EDUCATION IN THE UNITED STATES (2-3)
415S, 415X. MODERN TENDENCIES IN AMERICAN EDUCATION (1-6)
416X. SOCIAL EDUCATION (3)
421X. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)
424, 424X. VISUAL AND OTHER SENSORY AIDS FOR TEACHERS (1-3)
Professor VanderMeer
- 425S, 425X. THE SCIENTIFIC DIRECTION OF LEARNING ACTIVITIES (2-4)
426, 426X. EDUCATION OF EXCEPTIONAL CHILDREN (2-3) *Professor Neuber*
427. EDUCATION OF THE MENTALLY RETARDED (2-3) *Professor Neuber*
428, 428X. ADULT EDUCATION: ORGANIZATION, TYPES, AND METHODS (1-3) Units
A, B, C. *Professor Cologne*
- 429, 429X. EDUCATION OF THE MENTALLY GIFTED CHILD (1-3) *Professor Neuber*
430, 430X. VISUAL AND OTHER AIDS IN SAFETY EDUCATION (3)
431, 431X. PRINCIPLES AND METHODS OF TEACHING SAFETY EDUCATION (3)
432b, 432bX. THE ELEMENTARY SCHOOL READING PROGRAM (2-3)
Professors G. E. Murphy and L. C. Hunt
- 432c, 432cX. READING PROBLEMS IN THE SECONDARY SCHOOL (2-3)
Professors G. E. Murphy and L. C. Hunt
- 432d, 432dX. SPECIAL PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL ENGLISH (2-3) *Professor G. E. Murphy*
432eX. CHORAL SPEAKING (3) *Professor G. E. Murphy*
432f, 432fX. TEACHING SECONDARY SCHOOL ENGLISH (2-3) *Professor G. E. Murphy*
432g, 432gX. READING DISABILITIES (2-3) *Professor Hunt*
432h, 432hX. TECHNIQUES IN REMEDIAL READING (2-6) *Professor Hunt*
433e. ADVANCED THEORY OF KINDERGARTEN (3) *Professor Graffius*
433f, 433fX. TEACHING CHILDREN'S LITERATURE (2-3) *Professor G. E. Murphy*

- 433h, 433hX. PROBLEMS OF ELEMENTARY SCHOOL ARITHMETIC (2-3)
 433n, 433nX. TEACHING SOCIAL STUDIES IN THE ELEMENTARY GRADES (2-3)
 433w, 433wX. TEACHING SOCIAL STUDIES IN THE HIGH SCHOOL (2-3)
Professor VanderMeer
- 433y, 433yX. TEACHING MATHEMATICS IN THE SECONDARY SCHOOL (3)
 435X. EDUCATION FOR CITIZENSHIP (2-3)
 438, 438X. TEACHING SCIENCE IN SECONDARY SCHOOLS (2-3) *Professor Alfke*
 438e, 438eX. TEACHING SCIENCE IN THE ELEMENTARY SCHOOL (1-3)
 439, 439X. TEACHING TRAFFIC SAFETY AND AUTOMOBILE OPERATION (1-3)
Professor Neyhart, Mr. Intorre
- 441X. PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS (2-3)
 442, 442X. ELEMENTARY EDUCATION (2-3)
 445. PRODUCTION OF VISUAL AND AUDITORY MEDIA (2-9)
 446. DIAGNOSIS OF ATTAINMENT (3) *Mr. Cobb*
 448X. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3)
 449aS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3) *Professor Free*
 449bS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3) *Professor Free*
 450X. SECONDARY EDUCATION (2-3) *Professor Butler*
- 451X. SPECIAL PROBLEMS OF THE HIGH SCHOOL TEACHER (2-3)
 453, 453X. GUIDANCE PRINCIPLES AND PRACTICES (3) *Professor Wellington*
 454, 454X. EXTRACURRICULAR ACTIVITIES IN THE JUNIOR AND SENIOR HIGH SCHOOL (2-3) *Professors Moyer and Patrick*
 456, 456X. PRINCIPLES AND PROBLEMS IN BUSINESS EDUCATION (1-3)
Professors Gemmell and Veon
- 459, 459X. IMPROVEMENT OF INSTRUCTION IN BUSINESS SKILL SUBJECTS (1-3)
Professor Gemmell
 460. CURRICULUMS IN BUSINESS EDUCATION (3) *Professor Gemmell*
 461. IMPROVEMENT OF INSTRUCTION IN BASIC BUSINESS SUBJECTS (3) *Professor Gemmell*
 462. TEACHING OF SHORTHAND AND TYPEWRITING (3) *Professor Gemmell*
 463. TEACHING OF BOOKKEEPING (3) *Professors Gemmell and Veon*
 464. METHODS OF TEACHING DISTRIBUTIVE EDUCATION (3)
 466. TEACHING OF OFFICE PRACTICE (3) *Professor Veon*
 467. TEACHING OF SHORTHAND (2-3) *Professor Veon*
 468. TEACHING OF TYPEWRITING (2-3) *Professor Veon*
 470, 470X. EDUCATIONAL MEASUREMENTS (2-3) *Professor Davison*
 474, 474X. TEACHING AND GROUP GUIDANCE ABOUT OCCUPATIONS (3) *Professor Corle*
- 480, 480X. EDUCATIONAL ADMINISTRATION (2-3) *Professors Miller and Remaley*
 482X. SUPERVISION AND IMPROVEMENT OF INSTRUCTION (2-3)
 485X. CURRICULUM CONSTRUCTION (2-3)
 487, 487X. PROBLEMS IN VISUAL AND OTHER SENSORY AIDS IN EDUCATION (1-14)
 Unit A (1-3), Unit B (2-3), Unit C (3), Unit D (1-2), Unit E (3)
Professor VanderMeer
- 490X. PHILOSOPHY OF EDUCATION (3)
 491X. SCHOOL LAW (3)
 493, 493X. CHARACTER EDUCATION AND GUIDANCE (2-3) *Professor Chiappetta*
 494. RELIGIOUS EDUCATION (2-3)
 495S. (Ch.Fm. 495S, HI.Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)

EDUCATION

- 497S, 497X. WORKSHOP IN SELECTED STUDIES IN ELEMENTARY AND SECONDARY EDUCATION (1-6)
498, 498X. PRACTICUM IN THE EDUCATION OF ATYPICAL CHILDREN (3-6) Unit A (3), Unit B (3), Unit C (3), Unit D (3), Unit E (3)
499, 499X. PROBLEMS OF SPECIAL EDUCATION (3) *Professor Neuber*

ELECTRICAL ENGINEERING

PROFESSOR ARTHUR H. WAYNICK, M.S., Sc.D.

Head of the Department

520. SEMINAR (1) Required of all graduate students in electrical engineering. Conferences, reading, and presentation of technical papers.
- 521a,b,c,d. ALTERNATING-CURRENT THEORY (2-12) Special problems in alternating-current theory and application of these problems to alternating-current circuits or machinery at any frequencies.
523. TRANSIENTS IN LINEAR SYSTEMS (3) Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E.E. 423. *Professor Holt*
524. ENGINEERING ELECTRONICS (3) Special problems dealing with design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program. *Professor Stavely*
525. SYMMETRICAL COMPONENTS (3) Polyphase circuits and machines under unbalanced conditions of operation including effects of rotating machines upon distribution and transmission system performance; characteristics of phase converters and single-phase operation of polyphase systems. Prerequisite: E.E. 425. *Professor Holt*
528. SERVOMECHANISMS (3) Advanced treatment of transient and steady-state behavior of closed-cycle control systems with special attention to stability and design of stabilizing controllers. Prerequisite: E.E. 428. *Professor Tarpley*
530. AUDIO FREQUENCY ENGINEERING (3) Electrical systems and equipment used in production, recording, amplification, transmission, and measurement of sound. Prerequisite: E.E. 11 or 13. *Professor Hall*
- 531a,b,c. RADIO FREQUENCY ENGINEERING (3-9) Radio frequency equipment, measurements, and systems; amplifiers, modulators, demodulators, transmitters, receivers, transmission lines, antennae, and radiators. Prerequisite: E.E. 440. *Professor Hall*
532. ULTRA-HIGH-FREQUENCY ENGINEERING (4) Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E.E. 432. *Professor Hall*

ELECTRICAL ENGINEERING

533. AUTOMATIC CONTROL SYSTEMS (2-3) Automatic control, telemetering, and recording of electrical, mechanical, thermal, and chemical quantities. Prerequisite: E.E. 4. *Professor Rice*
535. ENGINEERING ANALYSIS (3) Engineering applications of complex variables, conformal mapping methods and potential plotting. Laplace transform methods and stability criteria. Prerequisite: E.E. 435. *Professor Davids*
538. ELECTROMAGNETIC ENGINEERING (3) Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E.E. 438.
550. COMMUNICATION NETWORKS (3) Methods of filter design using lattice networks; effects of dissipation on characteristics of filter networks; transient response of networks and design of equalizers. Prerequisite: E.E. 450. *Professor Tarpley*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 421a,b,c,d. ELECTRICAL ENGINEERING PROBLEMS (2-12)
423. TRANSIENT PHENOMENA (3) *Professor Holt*
424. ENGINEERING ELECTRONICS (3) *Professor Shields*
425. SYMMETRICAL COMPONENTS (3) *Professor Holt*
426. TRANSISTORS (3) *Professor Riddle*
- 428, 428X. SERVOMECHANISMS (3) *Professor Tarpley*
432. ULTRA-HIGH-FREQUENCY TECHNIQUES (3) *Professor Hall*
434. INDUSTRIAL ELECTRONICS (3) *Professor Stavelly*
- 435, 435X. ENGINEERING ANALYSIS (3) *Professor Tarpley*
436. DESIGN, CONSTRUCTION, AND TESTING OF VACUUM TUBES (3) *Professor Nearhoof*
438. FUNDAMENTALS OF ELECTRIC WAVES (3)
440. VACUUM-TUBE CIRCUITS I (3)
441. VACUUM-TUBE CIRCUITS II (3)
- 450, 450X. ELECTRICAL NETWORK THEORY (3) *Professor Tarpley*
460. HIGH-VOLTAGE ENGINEERING (3) *Professor Armington*
461. POWER SYSTEM RELAYING (3) *Professor Shields*

ELECTRICAL ENGINEERING LABORATORY

PROFESSOR ARTHUR H. WAYNICK, M.S., Sc.D.

Head of the Department of Electrical Engineering

The following courses may be taken for graduate credit under the restrictions in force:

440. ELECTRICAL COMMUNICATIONS LABORATORY I (1½)
441. ELECTRICAL COMMUNICATIONS LABORATORY II (1½)

ENGINEERING

Consult DEAN ERIC A. WALKER, S.M., Sc.D.

The following courses may be taken for graduate credit under the restrictions in force:

- 400. PRODUCTION ENGINEERING (3)
- 410. NUCLEAR ENGINEERING (3)

ENGINEERING MECHANICS

PROFESSOR JOSEPH MARIN, M.S., Ph.D.

Head of the Department

- 500. ADVANCED MECHANICS OF MATERIALS (3-6) Strain energy methods; special problems in bending and torsion; curved bars, beams on elastic foundations; thick-walled cylinders, shrink-fit assemblies, and rotating discs; thin-walled pressure vessels; bending of thin plates; buckling of bars and plates. Prerequisite: Mchs. 13. *Professors Marin and Hardenbergh*
- 504. APPLIED ELASTICITY (3) Analyses of stress and strain in two dimensions; problems in elasticity and elastic stability; emphasis on applications to machine and structural design. Prerequisite: Mchs. 13. *Professor Marin*
- 506. EXPERIMENTAL STRESS ANALYSIS (3) Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; stress analogies; strain rosettes for combined stress determinations. Prerequisite: Mchs. 13. *Professor Marin*
- 507. THEORY OF ELASTICITY AND APPLICATIONS (3-6) General equations of stress and strain; applications to beams, curved members, rotating discs, thick cylinders, torsion members, plates, and other structural and machine parts. Prerequisite: Mchs. 13. *Professors Marin and Hardenbergh*
- 508. THEORY OF ELASTIC STABILITY AND APPLICATIONS (3) Buckling of slender and short members; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to internal pressures; applications to structural parts including aircraft members. Prerequisites: Mchs. 12, 13.
- 509. THEORY OF PLATES AND SHELVES (3) Bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without bending; applications to engineering problems. Prerequisite: Mchs. 13. *Professor Davids*
- 514. ENGINEERING MECHANICS SEMINAR (1 per semester) Current literature and special problems in engineering mechanics.
- 520. ADVANCED DYNAMICS (3) Dynamics of a particle and of rigid bodies; Newtonian equations in moving co-ordinate systems; LaGrange's and Hamilton's equations of motion; special problems in vibrations and dynamics. Prerequisites: Mchs. 12, Math. 84 or 431. *Professors Davids and Sauer*

ENGINEERING MECHANICS

522. THEORY OF VIBRATIONS (3) Mathematical theory of vibrating systems; damping phenomena; forced vibrations; analogy between mechanical and electrical vibrations; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: Mchs. 13, Math. 84 or 431.

Professor Vierck

523. RELAXATION METHODS (3) Relaxation methods compared to iteration and other numerical methods of analysis; application to elasticity, plasticity, stability, fluid flow, heat transfer, and related fields. Prerequisite: Mchs. 522.

Professor Vierck

524. MATHEMATICAL METHODS IN ENGINEERING (3) Matrix and tensor analysis, finite differences, relaxation, perturbation, and other approximate methods in solution of various engineering problems. Prerequisite: Math. 451 or E.E. 435 or M.E.Des. 404.

Professor Davids

530. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for static and fatigue stresses; impact loads; creep of metals; applications to structural and machine design. Prerequisite: Mchs. 14.

Professor Marin

531. THEORY OF PLASTICITY AND APPLICATIONS (3) Theory of plasticity including plastic torsion and bending of bars; thick-walled cylinders and rotating discs; buckling of bars and residual stresses; mechanics of creep. Prerequisite: Mchs. 504 or 507.

Professor Marin

533. DETERMINATION OF MECHANICAL PROPERTIES (3) Experiments in fatigue, creep, impact, and combined stresses; true stress-strain diagrams.

540. MECHANICS OF CONTINUA (3) Unified mathematical treatment of elements of fluid mechanics and of elasticity and plasticity of solids. Prerequisite: Math. 84 or 431.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400, 400X. ADVANCED STRENGTH OF MATERIALS (3)

Professors Marin and Hardenbergh

401, 401X. ELEMENTS OF VIBRATIONS (3)

Professor Vierck

402. APPLIED AND EXPERIMENTAL STRESS ANALYSIS (3)

Professor Marin

403. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3)

Professor Marin

404. RESEARCH IN ENGINEERING MECHANICS (1-6)

ENGLISH

PROFESSOR THEODORE J. GATES, M.A.

Head of the Department of English Composition

PROFESSOR BRICE HARRIS, M.A., Ph.D.

Head of the Department of English Literature

501. MATERIALS AND METHODS OF RESEARCH (3) Bibliography of literary history and criticism; methods of editing and annotating texts; form and materials of

dissertations. Required of all graduate students with an English major.

Professor Ridenour

502. ANCIENT AND MEDIEVAL RHETORIC AND POETIC (3) Rhetorical and poetic doctrine of ancient and medieval times. *Professor Reed*
507. RESEARCH PROBLEMS IN ENGLISH (1-6) Methods of research in English, problems of bibliography, and method of evaluating sources and materials.
508. BEOWULF (3) Reading of the text and study of the prominent literary problems and relationships. *Professor Mead*
509. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE PROSE WRITERS (3) *Professor Mead*
510. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE POETS (3) *Professor Locklin*
511. ELIZABETHAN DRAMA (3) *Professor Harris*
514. SHAKESPEARE (3) Special problems in the works of Shakespeare. *Professor Bowman*
515. THE AGE OF SWIFT (3) Special studies varying from year to year. *Professor Harris*
516. THE AGE OF JOHNSON (3) The work of Johnson and his circle. *Professor Mead*
517. BYRON, SHELLEY, AND KEATS (3) *Professor Ridenour*
518. PRE-ROMANTIC WRITERS (3) Development of Romantic ideas in the 18th century. *Professor Ridenour*
519. WORDSWORTH, COLERIDGE, SOUTHEY, AND SCOTT (3) *Professor Ridenour*
530. HISTORY OF THE ENGLISH LANGUAGE (3) Germanic background of English, phonological and morphological developments, dialect differentiations, and principles of linguistic change. *Professor Mead*
531. OLD ENGLISH (3) Old English language and literature with lectures on Old English and Germanic philology. *Professor Mead*
532. MIDDLE ENGLISH (3) Middle English language and literature with lectures on the development of Old English through Middle English to modern times. *Professor Mead*
534. HISTORICAL ENGLISH GRAMMAR (3) Evolution of the grammatical system of English. *Professor Peck*
535. RENAISSANCE AND MODERN RHETORIC (3) The rhetorical and poetic doctrine of Renaissance and modern times. *Professor Rubin*
540. CHAUCER (3) Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences. *Professor Mead*
542. PROSE STYLE (3) Development of English prose style. *Professor Major*

543. CAVALIER AND ANGLICAN (3) Poetry and prose of the middle years of the 17th century from the death of Shakespeare to 1660. *Professor Mead*
544. RESTORATION LITERATURE (3) Selected studies of writers in England between 1650 and 1700. *Professor Harris*
545. POETS OF THE VICTORIAN PERIOD, EXCLUSIVE OF TENNYSON AND BROWNING (3) *Professor Long*
546. TENNYSON AND BROWNING (3) *Professor Long*
547. PROSE WRITERS OF THE VICTORIAN PERIOD (3) *Professor Long*
550. SELECTED STUDIES IN THE BRITISH NOVEL TO 1840 (3) *Professor Bowman*
551. SELECTED STUDIES IN THE BRITISH NOVEL FROM 1840 TO THE PRESENT (3) *Professor Sutherland*
562. THE AMERICAN NOVEL (3) *Professor Werner*
563. AMERICAN ESSAYS (3) Lectures and reports on a special group of essayists. *Professor Werner*
565. THE AMERICAN SHORT STORY (3) *Professor Werner*
566. AMERICAN POETRY (3) *Professor Werner*
567. ANGLO-AMERICAN FOLK SONG (3) Oral tradition of melodies and texts; types, regions, theories. *Professor Bayard*
580. PRE-SHAKESPEAREAN DRAMA (3) *Professor Harris*

ENGLISH COMPOSITION

PROFESSOR THEODORE J. GATES, M.A.

Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

404. PUBLIC OPINION AND WRITTEN PERSUASION (3) *Professor Graves*
418. THE WRITING OF LITERARY CRITICISM (3) *Professor Rubin*

ENGLISH LITERATURE

PROFESSOR BRICE HARRIS, M.A., Ph.D.

Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

400. TEACHERS' COURSE IN LITERATURE (3)
401. MAIN CURRENTS IN AMERICAN LITERATURE (3) *Professor Merrill*

ENGLISH LITERATURE

423. FORMS AND MOVEMENTS OF BRITISH LITERATURE (3) *Professor Ridenour*
 439a,b,cS. OUR CONTEMPORARIES (3)
 440a,b,cS. MASTERS OF LITERATURE (1-3)
 441a,b,cS. MASTERS OF ENGLISH LITERATURE (1-3)
 460. LITERARY BIOGRAPHY (3) *Professor Merrill*
 464. SPENSER (3) *Professor Locklin*
 466. MILTON (3)
 475a,b,cS. WORLD LITERATURE IN ENGLISH (3-9)
 484. AMERICAN DRAMA (3) *Professor Cloetingh*
 485. SCANDINAVIAN DRAMA (3) *Professor Cloetingh*
 486. LATER BRITISH AND IRISH DRAMATISTS (3) *Professor Cloetingh*
 487. MODERN CONTINENTAL DRAMA (3) *Professor Cloetingh*
 489a,b,cS. COMPOSITE COURSE IN DRAMA (3-9)
 489dS. CONTEMPORARY DRAMA (3)

ENTOMOLOGY

PROFESSOR BERTIL G. ANDERSON, M.S., Ph.D.

Head of the Department of Zoology and Entomology

505. ADVANCED MORPHOLOGY OF INSECTS (3) Advanced work in either external or internal morphology of insects. Prerequisites: Ent. 403, 405. *Professor Rutschky*
 506. IMMATURE INSECTS (3) The morphology and taxonomy of the immature stages of insects. Prerequisite: 9 credits in entomology. *Professor Blackburn*
 508. THE BIOLOGICAL CONTROL OF INSECTS (2) Artificial use of bacteria, fungus diseases, and animals in control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 6, 8, 407. *Professor Frost*
 509. ENTOMOLOGICAL TECHNIQUE (2) For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 6. *Professor Frost*
 513. ENTOMOLOGICAL RESEARCH (1-15 per semester) Prerequisites: Ent. 405, 407.
 514. ADVANCED SYSTEMATIC ENTOMOLOGY (1-15 per semester) Taxonomy of various orders of insects selected to meet the needs of the individual student. Prerequisites: Ent. 403, 405. *Professor Rutschky*
 528. INSECT PHYSIOLOGY (3) Normal functions of the insect body. Prerequisites: Ent. 405, A.B.Ch. 1. *Professor Dills*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. MEDICAL AND VETERINARY ENTOMOLOGY (3) *Professor Frings*
 403. SYSTEMATIC ENTOMOLOGY (3) *Professor Rutschky*
 405. INSECT MORPHOLOGY (3) *Professor Rutschky*
 407. INSECT ECOLOGY (3) *Professor Frost*

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| 413. ENTOMOLOGY SEMINAR (1 per semester) | Professor Frost |
| 429. PRINCIPLES OF INSECT CONTROL (3) | Professor Blackburn |
| 430. INSECT HISTOLOGY (2) | Professor Rutschky |
| 431. ENTOMOLOGICAL PROBLEMS (1-6) | |
| 445S. THE IDENTIFICATION OF INSECTS (3) | Professor Frost |

FAMILY ECONOMICS AND HOME MANAGEMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.

Head of the Department of Home Management, Housing, and Home Art

- 515, 515X. CONSUMER PROBLEMS (2-3) Methods of securing, evaluating, and presenting data concerning household commodities. For home economics teachers in high schools, colleges, and adult classes. Prerequisites: Fd.Ntr. 220, H.Mgmt. 442. *Professor Johnston*
524. ECONOMIC PROBLEMS OF THE HOUSEHOLD (3) Economic problems of the present-day family; special emphasis on factors in household production, use of money income, and standards of living. Prerequisites: H.Mgmt. 439, Econ. 14. *Professor Johnston*
528. HOME MANAGEMENT SUPERVISION (2-3) Evaluation of objectives and techniques in organization, supervision, and teaching of the home management house experience. Prerequisite: H.Mgmt. 439.
543. HOME MANAGEMENT IN RELATION TO FAMILY LIVING (3) Includes work with families in solution of their management problems. Prerequisites: Fd.Ntr. 220, H.Mgmt. 439. *Professor Wiesendanger*
544. SPECIAL PROBLEMS IN HOUSE MANAGEMENT (3) Specific management problems, such as social, financial, and material, including development of college level teaching aids. Prerequisites: 6 credits of home management or family economics courses in home economics. *Professor Wiesendanger*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 415, 415X. HOUSEHOLD BUYING PRACTICES (3) | Professor Johnston |
| 419, 419X. MANAGING FAMILY FINANCIAL RESOURCES (3) | Professor Honey |
| 423, 423X. (Fd.Ntr. 423). FAMILY FOOD PURCHASING (2) | |
| 424, 424X. ECONOMIC CONDITIONS IN RELATION TO THE FAMILY (3) | |
| 439, 439X. HOME MANAGEMENT (2) | |
| <i>Professors Frances Henderson and Muriel Starr</i> | |
| 442. RESIDENT EXPERIENCE IN HOME MANAGEMENT (3) Room and board will be charged at regular rates. | Professor Starr |
| 445. HOME MANAGEMENT EXPERIENCE (3) | Professor Starr |
| 477. FAMILY MANAGEMENT (3) | |

FOODS, NUTRITION, AND HEALTH

PROFESSOR MIRIAM E. LOWENBERG, M.S., Ph.D.

Head of the Department

520. READINGS IN FOODS (2) Critical review and reports of literature on selected food topics. *Professor Hester*
521. SEMINAR IN FOODS (1-6) Discussion and reports on current research in the foods field. Prerequisite or concurrent: Fd.Ntr. 520.
522. ADVANCED EXPERIMENTAL FOODS (3) Experimental methods used in measuring the quality of foods; specific problems in food preparation.
550. READINGS IN NUTRITION (3) Readings and reports of selected topics in nutrition. Prerequisite: Fd.Ntr. 450.
551. SEMINAR IN NUTRITION (1-6) Selected topics and recent advances in nutrition.
552. DIET IN DISEASES (3) Physiological and biochemical problems in metabolic diseases and the nutritional aspects of therapy.
553. NUTRITION OF CHILDREN (3) Nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: A.B.Ch. 35, Fd.Ntr. 450.
554. TECHNIQUES IN HUMAN NUTRITION RESEARCH (3) The more usual techniques employed by the research worker in human nutrition, accompanied by directed experience in their use and interpretation. Prerequisite or concurrent: Fd.Ntr. 551.
555. FIELD WORK IN NUTRITION (2-4) Field problems planned to meet the needs of individual students. Hours and problems to be arranged.
556. THE SURVEY METHOD IN FOODS AND NUTRITION (2) Study of survey technique as a tool in the assay of food adequacy and nutritional status. *Professor Dodds*
557. INTERRELATIONSHIPS OF NUTRIENTS (2) Interrelationships of nutrients in the metabolic processes; their significance as applied to nutrition.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. SPECIAL PROBLEMS IN FOODS AND NUTRITION (1-3)
420. EXPERIMENTAL COOKERY (1-6) *Professor Olson*
421. ADVANCED FOODS (3)
- 423, 423X. (H.Mgmt. 423). FAMILY FOOD PURCHASING (2)
425. FOOD PRESERVATION (2)
- 426S. RECENT DEVELOPMENTS IN FOODS (3)
450. NUTRITION (4) *Professor Padgett*
451. RECENT DEVELOPMENTS IN NUTRITION (3) *Professor Padgett*
452. ELEMENTS OF DIET IN DISEASE (3) *Professor Pike*
- 455, 455X. TEACHING NUTRITION TO BOYS AND GIRLS (3)
456. NUTRITION IN THE COMMUNITY (3)
- 491, 491v. TEACHING HOME NURSING (1)

FORESTRY

PROFESSOR MAURICE K. GODDARD, M.S.

Head of the Department

500. NATIONAL AND STATE ADMINISTRATION (3-5) Comparison of the policy and administration of the national forests with the forests of other countries and of the different states.
502. WOOD FIBERS (3-5) Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulp-
ing quality, fiber measurements. *Professor White*
504. RESEARCH METHODS IN FORESTRY (2-6 per semester) Review of methods em-
ployed in conducting forestry research. *Professor Chisman*
508. FOREST ECOLOGY (2-4) Organization, development, and classification of forest
communities. *Professor Bramble*
509. COVERT MANAGEMENT (2) Management of forest associations for maintenance
and development of wildlife. Prerequisite: For. 508. *Professor Bramble*
510. SEMINAR (1-2 per semester) Current problems of forest research presented
as weekly seminar reports. May be repeated with additional credit for each
semester's work. *Professor Bramble*
530. RESEARCH IN WOOD UTILIZATION (3-6 per semester) Research in some phase
of wood utilization of forest products. Prerequisite: For. 431. *Professor Norton*
531. STRUCTURAL USES OF WOOD AND WOOD PRODUCTS (3-6 per semester) Wood as
a construction material; testing techniques for structural timbers and wood
assemblies; use of laminated wood, ring connectors, and other types of special
construction. Prerequisite: For. 404. *Professor Norton*
532. LAMINATES (3-6 per semester) Advanced and special studies in fabrication
and use of plywood, laminated wood, paper-base laminates, and wood-to-metal
bonding. Prerequisite: For. 405. *Professor Norton*
535. CONDITIONING TREATMENTS FOR WOOD (3-6 per semester) Advanced study and
problems in preservative, seasoning, and other special treatments for wood and
wood products. Prerequisite: For. 435. *Professor Norton*
550. FOREST MENSURATION (2-8 per semester) Research in some chosen field. Pre-
requisite: For. 450. *Professor Meyer*
560. FOREST MANAGEMENT (3-8) Special topics in forest management and research
in some chosen field. Prerequisite: For. 466. *Professor Meyer*
575. APPLICATIONS OF FOREST ECONOMICS AND FINANCE (3 per semester) Survey of
situations in forestry where business problems and particular circumstances of
production, value, and costs are currently significant. Prerequisite: For. 70.
Professor Humphrey
590. THE LUMBER INDUSTRY (2-4) Relation of the lumber industry to national
economy and world trade; lumbermen's associations; lumber accounts. Prerequi-
site: For. 430.

FORESTRY

591. PROBLEMS IN LUMBERING (2-6) Research in some chosen phase of lumbering.
Prerequisite or concurrent: For. 590.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 400. ADVANCED SILVICULTURE (2) | Professor Chisman |
| 402. FOREST RESEARCH (2) | Professor Chisman |
| 404. MECHANICAL PROPERTIES OF WOOD (3) | Professor Nearn |
| 405. VENEER AND PLYWOOD (3) | Professors Norton and Nearn |
| 406. FORESTRY LITERATURE (1) | Professor White |
| 417. NATIONAL AND STATE FOREST PRACTICE (2) | |
| 421. REGIONAL SILVICULTURE (4) | Professor Cope |
| 427. FOREST RANGE MANAGEMENT (3) | Professor Chisman |
| 430. FOREST PRODUCTS AND INDUSTRIES (3) | Professor Nearn |
| 431. ADVANCED UTILIZATION (3-6) | Professors Norton and Nearn |
| 435. SEASONING AND PRESERVATION (3) | Professor Nearn |
| 445. IMPROVEMENTS (3) | Professor Worley |
| 450. ADVANCED MENSURATION (2) | Professor Meyer |
| 455. AERIAL PHOTOGRAMMETRY IN FOREST MANAGEMENT (2) | Professor Worley |
| 462. DEFECTS IN WOOD (3) | Professor Norton |
| 466. FOREST MANAGEMENT AND MANAGEMENT PLANS (4) | Professor Meyer |
| 468. SILVICULTURAL RESEARCH (2-4) | Professor Chisman |
| 469. PROBLEMS IN FOREST MANAGEMENT (3) | Professor Meyer |
| 475. PROBLEMS IN FOREST ECONOMICS AND FINANCE (3) | Professor Humphrey |
| 480. POLICY AND ADMINISTRATION (3) | |
| 491. LUMBERING (3) | Professor Schmidt |
| 492. LUMBER DISTRIBUTION (3) | Professor Schmidt |
| 494. LOGGING (3) | Professor Schmidt |
| 495. MILLING (3) | Professor Schmidt |
| 497. SMALL SAWMILLS (3) | Professor Schmidt |

FRENCH

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.
Head of the Department of Romance Languages

- *1G. ELEMENTARY FRENCH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.
544. NEOCLASSICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Neoclassic movement in Italy, France, Spain, and Portugal. Prerequisite: Fr. 40.
545. ROMANTICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Romantic movement in Italy, France, Spain, and Portugal.

* No graduate credit is given for this course.

- 546. MEDIEVAL ROMANCE LITERATURES (3) Nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal.
- 547. REALISM, WITH PARTICULAR REFERENCE TO ROMANCE LITERATURES (3)
- 548. 20TH CENTURY ROMANCE LITERATURE AS A POLITICAL FORCE (3)
- 551. ROMANCE PHILOLOGY (3) Historical development of the Romance languages.
- 552. OLD AND MIDDLE FRENCH READINGS AND LITERATURE (3) Familiarizes the student with Old and Middle French texts from the earliest monuments to Villon. Prerequisite: Fr. 551.
- 553. FRENCH LITERATURE OF THE RENAISSANCE (3) The French Renaissance from 1498 to 1548.
- 554. THE RENAISSANCE IN THE ROMANCE LITERATURES (3) Themes and forms of literature in the humanistic period.
- 562. FRENCH THINKERS OF THE 18TH CENTURY (3)
- 564. FRENCH ROMANTICISM (3) The French Romantic Movement after 1830.
- 570. VOLTAIRE AND ROUSSEAU (3)
- 571. SEMINAR IN FRENCH LITERATURE (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.
- 572. SEMINAR IN FRENCH LITERATURE (3) Continuation of Fr. 571.
- 574. METHODS AND BIBLIOGRAPHY IN ROMANCE LANGUAGES AND LITERATURES (1-2)
- 580. PROUST AND GIDE (3)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 400. FRENCH LITERATURE OF THE 16TH CENTURY (3)
- 401. FRENCH THEATER OF THE CLASSICAL PERIOD (3)
- 403. FRENCH DRAMATIC LITERATURE OF THE 18TH CENTURY (3)
- 405. FRENCH LITERATURE OF THE 19TH CENTURY (3)
- 406. FRENCH LITERATURE OF THE 19TH CENTURY (3)
- 407. FRENCH NOVEL OF THE 19TH CENTURY (3)
- 410. FRENCH POETRY OF THE 19TH CENTURY (3)
- 411. FRENCH PROSE OF THE 20TH CENTURY (3)
- 413, 413X. CONTEMPORARY FRENCH DRAMA (3)
- 415. FRENCH NOVEL OF THE 18TH CENTURY (3)
- 416. FRENCH POETRY AND DRAMA OF THE 20TH CENTURY (3)
- 421. THE TEACHING OF ROMANCE LANGUAGES (3)
- 471. PROBLEMS IN FRENCH LITERATURE (3-6)
- 490. ADVANCED COMPOSITION AND CONVERSATION (3)
- 496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

FUEL TECHNOLOGY

PROFESSOR C. C. WRIGHT, Ph.D.

Chief of the Division

502. RESEARCH DATA (3) Designed for the graduate student beginning laboratory research; methods of obtaining and interpreting research data. Prerequisite: Math. 30. *Professor Nielsen*
503. CHEMICAL CONSTITUTION AND SCIENTIFIC CLASSIFICATION OF COAL (3-6) Chemistry of plant constituents in relation to coal and the coalification process; constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. *Professor Kinney*
505. PHYSICOCHEMICAL PROPERTIES OF COAL, MINERAL MATTER, AND ASH (3) Physical, physicochemical, and use properties; their significance and applications. Prerequisite: Chem. 41.
506. ADVANCED COMBUSTION (3) Advanced combustion and heat balance calculations, ignition and flame characteristics of fuels; furnace atmospheres; selection of fuels with reference to use and equipment. Prerequisite: Chem. 41. *Professor Wright*
507. ADVANCED THERMAL PROCESSING (3) Pyrolysis, coal carbonization, coke manufacture and uses; action of heat on coals and fuels; technical and economic factors. Prerequisites: Chem. 35, 41, or Min.Pr. 410.
508. SYNTHESIS OF LIQUID FUELS (3) Chemical nature of liquid hydrocarbons; preparation of hydrogen and synthesis gas; theoretical and practical aspects of synthetic liquid fuel processes. Prerequisites: Chem. 31, Fuel T. 402. *Professor Kinney*
509. TECHNOLOGY OF TARS (3) Formation, constitution, physical and chemical properties of coal, oil-gas and water-gas tar; processing and utilization. Prerequisite: Chem. 31. *Professor Polansky*
510. FUEL TECHNOLOGY PROBLEM (1-6 per semester) Special problems in fuel technology. Prerequisite: Fuel T. 503. *Professor Wright and Staff*
511. FUEL TECHNOLOGY SEMINAR (1-6) Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 41. *Professor Wright and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. FUEL TECHNOLOGY RESEARCH AND DESIGN (1-3) *Professor Wright and Staff*
401. FUEL GASES AND GASIFICATION (3) *Professor Wright*
402. CHEMICAL PROCESSING OF FUELS (2) *Professor Kinney*
403. ENERGETICS OF FUEL TECHNOLOGY (3)
404. FUEL TECHNOLOGY DESIGN (3) *Professor Spicer*

GENERAL HOME ECONOMICS

PROFESSOR DOROTHY HOUGHTON, M.S., Ph.D.

Assistant Dean of the School of Home Economics

- 516, 516v. METHODS OF RESEARCH IN HOME ECONOMICS (3) Review of problems and techniques of research in home economics. Required of all graduate students in home economics. *Professor Hatcher*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

- 400, 400v, 400X, 400vX. RECENT FINDINGS IN HOME ECONOMICS (2-3)

GEOGRAPHY

PROFESSOR E. WILLARD MILLER, M.A., Ph.D.

Chief of the Division

503. ADVANCED REGIONAL GEOGRAPHY (3-12) Intensive study at an advanced level of selected regions or sections of the continents. Prerequisite: 12 credits in geography. *Professors Miller and Deasy*
504. PHYSICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professors Miller and Deasy*
505. ECONOMIC GEOGRAPHY SEMINAR (3-12) The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Miller*
506. CULTURAL AND POLITICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Griess*
510. PHYSICAL GEOGRAPHY RESEARCH (3-10) Original study in physical geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Deasy*
511. ECONOMIC GEOGRAPHY RESEARCH (3-10) Original study in economic geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Miller*
512. CULTURAL AND POLITICAL GEOGRAPHY RESEARCH (3-10) Original study in cultural and political geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Griess*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. REGIONAL GEOGRAPHY OF NORTH AMERICA (3) *Professor Deasy*
401. REGIONAL GEOGRAPHY OF PENNSYLVANIA (3) *Professor Miller*

GEOGRAPHY

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| 403. REGIONAL GEOGRAPHY OF SOUTH AMERICA (3) | <i>Professor Griess</i> |
| 405. CULTURAL GEOGRAPHY (3) | <i>Professor Griess</i> |
| 427S. REGIONAL GEOGRAPHY OF THE SOVIET UNION (3) | |
| 433. REGIONAL CLIMATOLOGY (3) | <i>Professor Deasy</i> |
| 435. FIELD METHODS IN GEOGRAPHY (3) | <i>Professor Miller</i> |
| 442. GEOGRAPHY OF EUROPE (3) | <i>Professor Miller</i> |
| 443. GEOGRAPHY OF THE ORIENT (3) | <i>Professor Rodgers</i> |
| 444. GEOGRAPHY OF AFRICA (3) | <i>Professor Griess</i> |
| 445. GEOGRAPHY OF THE AIR AGE (3) | <i>Professor Miller</i> |
| 452. INTERPRETATION OF AERIAL PHOTOGRAPHS (3) | <i>Professor Deasy</i> |
| 460. POLITICAL GEOGRAPHY (3) | <i>Professor Griess</i> |
| 480. GEOGRAPHY OF WORLD MANUFACTURING (3) | <i>Professor Miller</i> |

GEOLOGY

PROFESSOR FRANK M. SWARTZ, Ph.D.

Chief of the Division

- *500. GEOLOGY SEMINAR (1-9) Presentation, at weekly departmental meetings, of topics selected from geological literature.
- †501. STRATIGRAPHY (3-12) Principles of stratigraphic classification, lithofacies and biofacies, faunal zonation, correlation, sedimentation, and paleogeography, illustrated by stratigraphy of classical geologic regions: (a) Pre-Cambrian; (b) Paleozoic; (c) Mesozoic; (d) Cenozoic. Prerequisite: Geol. 464. *Professor Swartz*
- †503. PALEONTOLOGY (3-9) Morphology of animal groups significant for their fossils; nature of species and faunal zones. Seminars may be arranged for studies of special fossil groups, microfossils, paleoecology. *Professor Swartz*
504. HISTORY OF GEOLOGY (2-3) Development through the ages of the scientific method in earth sciences. *Professor Krynine*
507. SEMINAR IN GEOMORPHOLOGY (3-6) Classic and current literature in geomorphology. *Professor Miller*
511. ORE DEPOSITS: PRINCIPLES (3-6) Geological and geochemical processes controlling ore deposition; genetic classification of ore deposits. Prerequisite: Geol. 451. *Professor Ridge*
512. ORE DEPOSITS: TYPES (1-6) Geologic history and field examination of selected ore bodies; forming media; causes, sequences, and loci of emplacement; wall rock alteration; secondary enrichment. Prerequisite: Geol. 511. *Professor Ridge*
515. ORE MICROSCOPY (2-3) Theory and use of the ore microscope in identifying ore minerals in polished section, establishing paragenetic sequences, determining manner of deposition. *Professor Ridge*
520. SEMINAR OF PALEOBOTANY (2-6) Current and classic literature concerning evolution, paleoecology, and geologic history of vascular plants. *Professor Spackman*

* Credits to be arranged, 1 to 6 per semester.

† Credits to be arranged, 3 to 6 per semester.

524. COAL PETROLOGY (1-6) Microscopy, source materials, coalification, constitution, classification of peats, lignites, bituminous coal, anthracite.

Professor Spackman

530. GEOLOGICAL PROBLEMS (3-6) Study, from the literature, of a selected geological problem. Prerequisite: 10 credits of geology and mineralogy.

545. GLACIAL GEOLOGY (3) Glaciers: their characteristics, causes, deposits, land forms, effects in periglacial regions.

Professor Miller

551. GEOTECTONICS (3-6) Tectonic principles and elements: nature and development of geosynclines, island arcs, mountain structures, stable masses, cratons, mobile belts.

Professor Scholten

571. PETROLEUM PROVINCES OF THE WORLD (3) Stratigraphy, structure, geologic history, and oil and gas occurrence in major petroliferous provinces.

Professor Scholten

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 420. PALEOBOTANY (3) | <i>Professor Spackman</i> |
| 424. GEOLOGY OF COAL (2) | <i>Professor Nickelsen</i> |
| 451. ECONOMIC GEOLOGY (3) | <i>Professor Scholten</i> |
| 461. GEOLOGY OF THE UNITED STATES (3) | <i>Professor Miller</i> |
| 462. PRINCIPLES OF GEOMORPHOLOGY (3-6) | <i>Professor Miller</i> |
| 464. PALEONTOLOGY (3) | <i>Professor Swartz</i> |
| 481. GEOLOGY OF OIL AND GAS (3) | <i>Professor Scholten</i> |
| 482. METALLIC MINERAL DEPOSITS (3) | <i>Professor Ridge</i> |
| 483. STRUCTURAL GEOLOGY (3) | <i>Professor Nickelsen</i> |
| 484. PALEOZOIC STRATIGRAPHY (3) | <i>Professor Swartz</i> |
| 485. PALEONTOLOGY (2) | <i>Professor Swartz</i> |
| 486. STRATIGRAPHIC METHODS (1) | <i>Professor Swartz</i> |
| 488. EARTH SCIENCES SEMINAR (1) | |
| 489. EARTH SCIENCES REPORT (1) | |

GEOPHYSICS AND GEOCHEMISTRY

PROFESSOR B. F. HOWELL, JR., M.S., Ph.D.

Chief of the Division

500. GEOPHYSICAL SEMINAR (1 per semester) Discussion of geophysical reports and papers; scientific outlook. Prerequisites: G.&G. 401, 402.

Professor Howell

501. RESEARCH (1-15 per semester) Original research in geophysics or geochemistry.

502. SEISMIC INSTRUMENTS (2) Characteristics and design of seismometers and seismic recorders. Given alternate years. Prerequisites: Phys. 285, differential equations.

Professor Howell

503. SPECIAL STUDIES IN GEOPHYSICS (1-9) Special studies of the theories of geophysical methods. Prerequisite: 6 credits in geophysics.

GEOPHYSICS AND GEOCHEMISTRY

507. SEISMOLOGY (3) Nature and transmission of seismic waves; cause and occurrence of earthquakes; applications in seismic prospecting. Prerequisites: Math. 431, Phys. 285. *Professor Howell*
508. TECTONICS (3) Seminar in the cause and nature of the principal deformations of the earth. Prerequisite: Geol. 483. *Professor Howell*
509. GEOCHEMISTRY SEMINAR (1 per semester) Prerequisite: G.&G. 406. *Professor Keith*
510. PROBLEMS IN GEOCHEMISTRY (1-9) Laboratory and library study of special problems. Prerequisite: G.&G. 406.
511. STRUCTURE AND PROPERTIES OF MINERAL MATTER (2-6) *Professor Brindley*
512. PRINCIPLES OF ELEMENT DISTRIBUTION IN THE EARTH (3-6) Principles and data from phase equilibrium, petrologic, and crystal structure studies as related to distribution of elements in the earth. Prerequisite: G.&G. 513. *Professor Keith*
513. PHASE EQUILIBRIA IN MINERAL SYSTEMS (3-6) Phase relations and constitution of inorganic crystals and liquids; special emphasis on systems closely related to natural magmas and rock systems. Prerequisite: Min. 483. *Professors Osborn and Roy*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. MINING GEOPHYSICS (3)
402. PETROLEUM GEOPHYSICAL PROSPECTING (3) *Professor Howell*
403. GEOPHYSICS FIELD WORK (1-3) Summer practicum.
404. MINING GEOPHYSICS LABORATORY (1)
405. INTRODUCTORY GEOPHYSICS (3) *Professor Howell*
406. INTRODUCTORY GEOCHEMISTRY (3) *Professor Keith*
407. WELL LOGGING (2)
408. POTENTIAL THEORY APPLIED TO EARTH PROBLEMS (3)

GERMAN

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.

Head of the Department

- *1G. ELEMENTARY GERMAN FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.
501. GERMAN LANGUAGE SEMINAR (3-9) Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.
515. GERMAN LITERATURE SEMINAR (3-9) Special aspects and characteristics of individual writers and various types and periods of literature.
524. INTENSIVE STUDY OF THE LIFE AND WORKS OF GOETHE (3) Various phases of the poet's life and individual works. *Professor Buffington*

* No graduate credit is given for this course.

G E R M A N

531. SPECIAL STUDIES IN THE GERMAN LYRIC (3) Professor Shelley
 532. SPECIAL STUDIES IN THE GERMAN DRAMA (3) Professor Adolf
 533. SPECIAL STUDIES IN THE GERMAN SHORT STORY (3) Professor Steiner
 534. SPECIAL STUDIES IN THE GERMAN NOVEL (3) Professor Adolf
 551. MIDDLE HIGH GERMAN (3) Extensive reading of texts; characteristics of the various dialects. Professor Buffington
 552. OLD HIGH GERMAN (3) Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A.D. Papers. Professor Buffington
 553. GOTHIC (3) Essentials of the grammar; reading of Ulfilas' Bible translation. Suitable also for advanced students in English. Professor Adolf

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. PROSEMINAR IN BIBLIOGRAPHY AND METHODS OF RESEARCH (2) Professor Shelley
 401. HISTORY OF THE GERMAN LANGUAGE (3) Professor Buffington
 421. GERMAN LITERATURE IN THE 18TH CENTURY (3) Professor Buffington
 422. GERMAN LITERATURE IN THE 19TH CENTURY (3) Professor Adolf
 423. GERMAN LITERATURE OF THE 20TH CENTURY (3) Professor Steiner
 443. LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9) Professor Shelley

GREEK

PROFESSOR ROBERT E. DENGLE, A.M., Ph.D.

Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following 400 and 500 courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

500. GREEK COMPOSITION (2) Translation of extended narrative passages into Attic Greek; thorough review of forms and syntax; attention to rhetorical elements of the language. Professor Dengler

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

- 411S. ESSENTIALS OF GREEK (3)
 421. GREEK TRAGEDY (3) Professor Dengler
 422. GREEK COMEDY (3) Professor Dengler
 423. ATTIC ORATORS (3) Professor Dengler
 424. GREEK HISTORY OR PHILOSOPHY (3) Professor Dengler
 427. NEW TESTAMENT GREEK (3) Professor Dengler

HEALTH EDUCATION

Consult PROFESSOR ARTHUR L. HARNETT, JR., M.A., Ed.D.

501. HEALTH IMPLICATIONS IN THE GROWTH AND DEVELOPMENT OF SCHOOL CHILDREN (3) Child growth and development emphasis for teachers; medical inspection and examination; preschool program; early habit formations; behavior problems; co-operation of parents, teachers, and children. Prerequisite: Hl.Ed. 215.

Professor Davis

505. ADVANCED TECHNIQUES IN HEALTH EDUCATION (3) Prerequisites: Hl.Ed. 215, 399, Psy. 437.

Professor Harnett

572. TESTS AND MEASUREMENTS IN HEALTH EDUCATION (3) Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Ph.Ed. 490, Hl.Ed. 215, 399.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

403. FIRST AID, ATHLETIC CONDITIONING AND TRAINING (3)

Professor Medlar

405. RECENT DEVELOPMENTS IN PUBLIC HEALTH EDUCATION (3-6)

Professor Davis

406. RECENT DEVELOPMENTS IN SCHOOL HEALTH EDUCATION (3)

Professor Harnett

- 407, 407X. ADVANCED PERSONAL AND PUBLIC HEALTH (3)

Professor Harnett

- 411, 411X. SAFETY EDUCATION IN THE SCHOOLS (3)

Professor Davis

427. HEALTH FACTORS IN THE DEVELOPMENT OF THE ADOLESCENT (3)

Professor Davis

- 453, 453X. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION (3)

Professor Harnett

- 455S. RELATIONSHIPS OF HEALTH EDUCATION TO THE EXACT SCIENCES (3)

Professor Harnett

456. ADVANCED TECHNIQUES IN RURAL SCHOOL HEALTH (3)

Professor Harnett

- 495S. (Ch.Fm. 495S, Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)

Professor Davis

HISTORY

PROFESSOR PHILIP S. KLEIN, M.A., Ph.D.

Head of the Department

500. SEMINAR IN AMERICAN HISTORY (3-6) *Professors Gray, Hermann, and Klein*

501. EUROPEAN HISTORIOGRAPHY (3) *Professor Pundt*

502. AMERICAN HISTORIOGRAPHY (3) *Professor Klein*

506. THE DIPLOMATIC BACKGROUND OF WORLD WAR I, 1871-1914 (3) Prerequisites: Hist. 18, 19.

507. THE REFORM MOVEMENT IN MODERN ENGLAND, 1832 TO THE PRESENT (3) *Professor Pundt*

508. STUDIES IN EUROPEAN HISTORY, 1600-1789 (3) *Professor Pundt*

509. THE FRENCH REVOLUTION AND NAPOLEONIC ERA, 1789-1815 (3) Prerequisites:
Hist. 18, 19. *Professor Pundt*
511. SEMINAR IN EUROPEAN HISTORY (3-6) *Professors Forster and Pundt*
512. STUDIES IN PENNSYLVANIA HISTORY (3-6) *Professor Klein*
520. THE AMERICAN REVOLUTION, 1763-1783 (3) Prerequisites: Hist. 20, 21.
Professor Hermann
529. CULTURAL HISTORY OF THE EARLY MIDDLE AGES (3) *Professor Dahmus*
532. STUDIES IN MEDIEVAL CIVILIZATION (3) *Professor Dahmus*
533. STUDIES IN THE HISTORY OF THE UNITED STATES, 1829-1860 (3) *Professor Klein*
534. THE CIVIL WAR AND RECONSTRUCTION, 1860-1877 (3) Prerequisites: Hist. 20,
21. *Professors Klein and Hermann*
536. STUDIES IN THE HISTORY OF THE UNITED STATES, 1877-1900 (3)
538. STUDIES IN THE HISTORY OF FOREIGN RELATIONS OF THE UNITED STATES, 1492
TO THE PRESENT (3)
562. SEMINAR IN LATIN-AMERICAN HISTORY (3-6) Prerequisites: Hist. 22, 23.
Professor Gray
563. STUDIES IN THE HISTORY OF THE CARIBBEAN AREA (3) Prerequisites: Hist.
22, 23. *Professor Gray*

*In addition to these courses, the following may be taken for graduate credit under
the restrictions in force:*

- 405, 405X. HISTORICAL BACKGROUND OF AMERICAN POLITICAL PARTIES, 1607-1900 (3)
Professor Rayback
406. HISTORY OF AMERICAN LABOR (3) *Professor Rayback*
407. THE DIPLOMATIC HISTORY OF THE UNITED STATES (3) *Professor DeNovo*
418. RENAISSANCE AND REFORMATION (3) *Mr. Green*
- 419, 419X. RECENT EUROPEAN HISTORY (3) *Professor Forster*
- 421, 421X. RECENT AMERICAN HISTORY (3)
423. THE FORMATIVE PERIOD OF AMERICAN HISTORY (3) *Professor Klein*
437. THE MIDDLE AGES FROM CONSTANTINE TO THE CRUSADES (3) *Professor Dahmus*
438. THE MIDDLE AGES FROM THE CRUSADES TO THE RENAISSANCE (3)
Professor Dahmus
439. HISTORY OF ENGLAND TO 1485 (3) *Professor Dahmus*
440. HISTORY OF ENGLAND AND GREAT BRITAIN SINCE 1485 (3) *Professor Forster*
441. RECENT HISTORY OF GREAT BRITAIN (3) *Professor Forster*
443. HISTORY OF MODERN RUSSIA (3) *Dr. Thaden*
444. EASTERN EUROPE IN MODERN TIMES (3) *Dr. Thaden*
446. DEVELOPMENT OF THE BRITISH EMPIRE (3)
447. ECONOMIC DEVELOPMENT OF MODERN EUROPE SINCE 1750 (3) *Professor Pundt*
448. SOCIAL AND CULTURAL HISTORY OF MODERN EUROPE (3)
450. ECONOMIC DEVELOPMENT OF COLONIAL AMERICA, 1607-1783 (3) To alternate
with Hist. 451. *Professor Hermann*
451. SOCIAL AND CULTURAL HISTORY OF COLONIAL AMERICA, 1607-1783 (3) To alter-
nate with Hist. 450. *Professor Hermann*

HISTORY

452. SOCIAL AND CULTURAL HISTORY OF THE UNITED STATES SINCE 1783 (3)
Professor Brown
453. AMERICAN POLITICAL BIOGRAPHY (3) Professor Hermann
454. THE ECONOMIC DEVELOPMENT OF THE UNITED STATES IN THE 19TH CENTURY (3)
Professor McNall
460. LATIN AMERICA AND THE UNITED STATES (3) Professor Gray
461. SOCIAL AND CULTURAL HISTORY OF LATIN AMERICA (3) To alternate with
Hist. 460. Professor Gray
499X. FOREIGN STUDY IN HISTORY (2-6)

HOME ART

PROFESSOR CHRISTINE F. SALMON, B.Arch., M.Arch.
Chairman of the Division

515. BACKGROUNDS OF THE HOME ARTS (3) Evaluation of useful objects in respect to their form, function, and time; selections for exhibition. Prerequisites: H.Art 216 or Art 54 or Art Ed. 6, and Art 74 or H.Art 240.
541. ART IN THE ENVIRONMENT (3) Approach based upon human needs with consideration of materials in the light of their use in home living. Prerequisite: Art 76 or Art Ed. 5 or H.Art 440.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. SPECIAL PROBLEMS IN HOME FURNISHINGS (3)
433, 433X. ADVANCED HOME CRAFTS (2-12)
434. THE ART AND THE CRAFTS IN THE HOMEMAKING PROGRAM (3-6)
440, 440X. HOME FURNISHING PROBLEMS (3)
443. HOME ARTS IN THE ADULT PROGRAM (3)
444, 444X. HOME FURNISHING TEACHING PROBLEMS (3)
447, 447X. HOME FURNISHINGS FOR THE FAMILY (3)

HOME-COMMUNITY RELATIONSHIPS

PROFESSOR DOROTHY HOUGHTON, M.S., Ph.D.
Assistant Dean of the School of Home Economics

- 502, 502v, 502X, 502vX. HOME ECONOMICS AND AMERICAN SOCIETY (3) Family life education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.
503. GRADUATE SEMINAR IN HOME ECONOMICS (1) Professor Henderson

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 499X. INTERCULTURAL STUDIES IN HOME ECONOMICS (2-6)

HOME ECONOMICS EDUCATION

PROFESSOR JEAN D. AMBERSON, M.A., Ph.D.

Head of the Department

502, 502v. HOME ECONOMICS INSTRUCTION AT THE COLLEGE LEVEL (3) Teaching techniques suitable for college instruction in home economics; for prospective home economics college teachers not majoring in home economics education.

503, 503v. PROBLEMS IN HOME ECONOMICS TEACHER EDUCATION (3) Organization of college programs of teacher education; use of resources; records; field services; recruitment and selection of personnel. Prerequisite: at least two years of experience in teaching home economics.

504, 504v. CURRENT DEVELOPMENTS IN EDUCATION IN RELATION TO HOME ECONOMICS (3) Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics.

Professor Amberson

505, 505v, 505X, 505vX. PRACTICUM IN TEACHING HOME ECONOMICS IN THE SECONDARY SCHOOL (3-6) Projects in home economics education which may be carried out in the school in which the teacher is regularly employed.

Professor Hillier

509, 509v, 509X, 509vX. CURRICULUM WORKSHOP IN FAMILY LIFE EDUCATION (3) Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics. *Professor Amberson, Hatcher, or Hillier*

510, 510v, 510X, 510vX. THE SUPERVISION OF HOME ECONOMICS TEACHING (2-6) For teachers of home economics desiring to qualify as city, county, or student teacher supervisors. Prerequisite: graduation from a four-year teacher training curriculum and two years' teaching experience in home economics.

Professor Amberson, Hillier, or Riegel

518, 518v, 518X, 518vX. EVALUATION IN FAMILY LIFE EDUCATION (3) Methods of evaluating progress toward goals in home economics education and use of findings in program planning and revision. *Professor Amberson, Hatcher, or Hillier*

521, 521v, 521X, 521vX. HOME ECONOMICS EDUCATION SEMINAR (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems. *Professor Amberson or Hatcher*

526, 526v, 526X, 526vX. THE COMMUNITY PROGRAM IN FAMILY LIFE EDUCATION (2-3) Ways of discovering community needs and resources; methods in developing the community program in family living; leadership education for the lay member of the community.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

406, 406v, 406X, 406vX. TEACHING AIDS IN FAMILY LIFE EDUCATION (1-4)

427, 427v, 427X, 427vX. FAMILY LIFE EDUCATION (3)

HOME ECONOMICS EDUCATION

- 443, 443v, 443X, 443vX. ADULT HOMEMAKING EDUCATION (3)
463, 463v. SENIOR SEMINAR (1)
466, 466v. STUDENT TEACHING (9)
478, 478v, 478X, 478vX. APPRAISING STUDENT PROGRESS IN EDUCATION FOR FAMILY LIVING (3)
479, 479v, 479X, 479vX. READINGS IN HOME ECONOMICS EDUCATION (1-4)

HORTICULTURE

PROFESSOR RUSSELL E. LARSON, M.S., Ph.D.

Head of the Department

500. ECOLOGY OF FRUIT PLANTS (3) Factors limiting the distribution and intensity of culture of fruit species and varieties and effect of environmental factors on cultural practices.
501. POMOLOGY RESEARCH (2-12) Investigation of problems involving review of literature, field and laboratory research. Prerequisite or concurrent: Hort. 445.
Professor White
503. EXPERIMENTAL PLANT BREEDING (3-6) Problems based mainly on research work of the department, with review of experimental methods and literature. Prerequisite: Hort. 444.
Professor Larson
504. VEGETABLE CROP RESEARCH (2-9) Investigation of problems involving review of literature, field and laboratory research. Prerequisite: Hort. 420 or 424.
Professor Odland
505. PROBLEMS IN VEGETABLE PRODUCTION (2-6) Methods used in the more valuable contributions to vegetable production. Prerequisite: Hort. 420 or 424.
Professor Odland
506. NUTRITION OF HORTICULTURAL CROPS (2-4) Principles, applications, and interpretations of diagnostic methods for determining fertilizer requirements of horticultural crops.
Professor Smith
507. PLANT BREEDING RESEARCH (3-6) Critical review of breeding projects of the department, with original investigations. Prerequisite: Hort. 444.
Professor Larson
512. PRINCIPLES OF FRUIT AND VEGETABLE STORAGE (2-4) Principles involved in the maturation, storage, and senescence of fruits and vegetables, and their application.
513. RESEARCH IN ORNAMENTAL HORTICULTURE (2-12) Review of research in ornamental horticulture, with original investigations.
Professor Meahl
514. PROPAGATION OF ORNAMENTAL AND FRUIT PLANTS (3) Factors affecting the asexual and sexual propagation of fruit and ornamental plants. *Professor Meahl*

HORTICULTURE

517. **HORTICULTURE SEMINAR** (1 per semester) Review of current research publications in horticulture. Each student presents one or more reviews of assigned topics.
518. **RESEARCH PROBLEMS IN LANDSCAPE HORTICULTURE** (2-12) Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. *Professor Bracken*
519. **SEMINAR ON THE GENETICS OF HORTICULTURAL CROPS** (1 per semester) Review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics.
520. **SEMINAR ON THE BREEDING OF HORTICULTURAL CROPS** (1 per semester) Each student presents one or more reviews of literature on assigned topics.
521. **TECHNICAL PRACTICES IN LANDSCAPE CONTRACTING** (2-12) Commercial and technical operations in landscape contracting and maintenance services. Prerequisites: Hort. 460, 461. *Professor Bracken*
523. **PROPAGATION AND IMPROVEMENT OF VEGETABLE AND FLOWER CROPS** (3) Methods and special techniques in breeding of flowers and vegetables; maintenance of seed stocks and seed production. Prerequisite: Hort. 444. *Professor Odland*
524. **EXPERIMENTAL PROCEDURES IN HORTICULTURAL RESEARCH** (3) *Professor Larson*
525. **HORTICULTURAL RESEARCH TECHNIQUES** (3) Practice in and comparison of methods and apparatus used in horticultural research. *Professor White*
526. **RESEARCH IN FLORICULTURE** (2-12) Greenhouse research and review of literature. Prerequisite or concurrent: Hort. 427, 428. *Professor Seeley*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 412. STORAGE OF HORTICULTURAL CROPS (3) | <i>Professor Ritter</i> |
| 418. SUBTROPICAL AND TROPICAL FRUITS (3) | <i>Professor White</i> |
| 420. ADVANCED COMMERCIAL VEGETABLE PRODUCTION (3) | <i>Professor Odland</i> |
| 423. ADVANCED FRUIT AND VEGETABLE PROCESSING (3) | <i>Mr. Thomas</i> |
| 424. ADVANCED OLERICULTURE (3-6) | <i>Professor Odland</i> |
| 427. ADVANCED FLORICULTURE (3) | <i>Professor Seeley</i> |
| 428. ADVANCED FLORICULTURE (3) | <i>Professor Seeley</i> |
| 434. RECREATION AREAS AND FACILITIES (4) | <i>Professor Wilson</i> |
| 444. ADVANCED PLANT BREEDING (3-6) | <i>Professor Larson</i> |
| 445. ADVANCED POMOLOGY (3) | <i>Professor White</i> |
| 446. ADVANCED POMOLOGY (3) | <i>Professor White</i> |
| 447. PROBLEMS IN POMOLOGY (1-6) | <i>Professor White</i> |
| 453. NURSERY PRINCIPLES AND PRACTICE (3) | <i>Professor Meahl</i> |
| 454. LANDSCAPE PROBLEMS (3-6) | <i>Professor Bracken</i> |
| 455. LANDSCAPE PROBLEMS (3-6) | <i>Professor Bracken</i> |
| 456. PROBLEMS IN NURSERY PRACTICE (3) | <i>Professor Meahl</i> |
| 460. LANDSCAPE HORTICULTURE PROJECTS (3-6) | <i>Professor Bracken</i> |
| 461. PARKS AND PARK ADMINISTRATION (3-6) | <i>Professor Wilson</i> |
| 462. INSTITUTIONAL GROUNDS AND THEIR ADMINISTRATION (3-6) | <i>Professor Wilson</i> |
| 463. LANDSCAPE HORTICULTURE PROJECTS (1-6) | <i>Professor Bracken</i> |

HOTEL ADMINISTRATION

HOTEL ADMINISTRATION

PROFESSOR ESTHER A. ATKINSON, M.S.

Head of the Department of Hotel and Institution Administration

The following courses may be taken for graduate credit under the restrictions in force:

440. HOTEL OPERATIONAL LIABILITIES (2)

Professor Bower

445. HOTEL ORGANIZATION AND OPERATION (3)

Professor Bower

HOUSING AND HOME EQUIPMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.

Head of the Department of Home Management, Housing, and Home Art

The following courses may be taken for graduate credit under the restrictions in force:

413, 413X. HOME EQUIPMENT (3)

470, 470X. HOUSING THE FAMILY (2-3)

INDUSTRIAL ARTS

PROFESSOR S. LEWIS LAND, M.S., Ph.D.

Head of the Department of Industrial Education

PROFESSOR JOHN F. FRIESE, M.S.

574. HISTORY AND PHILOSOPHY OF INDUSTRIAL ARTS (2-3) Historical developments and concurrent educational philosophies of industrial arts in American education. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

575. PROBLEMS IN INDUSTRIAL ARTS EDUCATION (2-3) Subject matter, projects, methods of manual and informational teaching, aids and devices, selection of text and reference materials, personnel organization, shop management, problem pupils. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

576. SUPERVISION AND ADMINISTRATION OF INDUSTRIAL ARTS EDUCATION (2-3) How to organize, supervise, and administer functioning programs of industrial arts; duties of a supervisor and director of industrial arts. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

577. TESTING IN INDUSTRIAL ARTS (2-3) Construction of informal manipulative and written tests; use of standardized mechanical aptitude and achievement tests; construction and use of rating scales; scoring and grading; interpretation of test

results. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

578. RESEARCH IN INDUSTRIAL ARTS (2-3) Research techniques in industrial arts education.

580. SEMINAR IN INDUSTRIAL ARTS (2-9) Directed intensive study, investigation, or research in selected phases of the program; reports and constructive criticism. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

407, 407X. INDUSTRIAL ARTS EDUCATION (2-3)

421, 421X. CURRICULUM MATERIALS IN INDUSTRIAL ARTS (2-3)

470, 470X. PROBLEMS IN SENIOR HIGH SCHOOL INDUSTRIAL ARTS (2-3)

INDUSTRIAL EDUCATION

PROFESSOR S. LEWIS LAND, M.S., Ph.D.

Head of the Department

501v. SEMINAR IN VOCATIONAL EDUCATION (1-12) Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators.

506v. ADMINISTRATION OF VOCATIONAL EDUCATION (1-6) The job of the local director of industrial education in organizing and developing city and other local programs of industrial education. Prerequisite: 6 credits in industrial education or valid director's certificate, equivalent training and experience.

510v. VOCATIONAL EDUCATION FOR ADMINISTRATORS (2-3) Designed for school administrators and supervisors who desire an understanding of practical arts and vocational education. Prerequisite: Ind.Ed. 1v or trade or teaching experience.

550v. RESEARCH IN VOCATIONAL EDUCATION (2-3) Research techniques in vocational industrial education.

555v. CURRENT PROBLEMS IN VOCATIONAL EDUCATION (1-6) Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome.

Unit A. Changing Industrial, Economic, and Social Conditions (1)

Unit B. Policies and Program of the American Vocational Association (1)

Unit C. Federal and State Vocational Legislation, Present and Pending (1)

Unit D. Financing Vocational Education (1)

Unit E. Current Administrative Problems in Vocational Education (1)

Unit F. Current Administrative Problems in Vocational Education (cont'd) (1)

558v. FRONTIER PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (2-3 per unit)

Unit A. Federal Legislation (2-3)

Unit B. Present-Day Local Personnel and Curriculum Problems (2-3)

Unit C. State and Local Supervision and Administration (2-3)

INDUSTRIAL EDUCATION

560v. PHILOSOPHY OF INDUSTRIAL EDUCATION (2-3) Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices. Prerequisite: 12 credits in industrial education or teaching experience.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401v, 401vX. HISTORY OF INDUSTRIAL EDUCATION (2-3)
- 402v, 402vX. SUPERVISION OF VOCATIONAL EDUCATION (2-3)
- 403v, 403vX. SUPERVISED FIELD WORK (1-6)
- 405v, 405vX. CONFERENCE LEADER TRAINING (2-3)
- 408v, 408vX. OCCUPATIONS (2-3)
- 409v, 409vX. TESTS AND MEASUREMENTS (2-3)
- 412v, 412vX. SPECIAL PROBLEMS IN VOCATIONAL EDUCATION (2-4)
- 414v, 414vX. VOCATIONAL EDUCATIONAL GUIDANCE (2-3)
- 415vS, 415vX. PROBLEMS IN CO-ORDINATING VOCATIONAL EDUCATION (2-3)
- 418v, 418vX. PROBLEMS IN AUDIO-VISUAL AIDS IN INDUSTRIAL EDUCATION (2-3)
- 420v, 420vX. OCCUPATIONAL HYGIENE (2-3)
- 425v, 425vX. WORKSHOP IN INDUSTRIAL EDUCATION (1-6)
- 427v, 427vX. ADVANCED COURSE OF STUDY BUILDING (2-3)
- 446vS, 446vX. IMPROVEMENT OF INSTRUCTION IN VOCATIONAL EDUCATION (2-4)
- 450v, 450vX. SHOP LAYOUT AND MANAGEMENT (2-3)
- 458v. EMERGING PROBLEMS IN VOCATIONAL EDUCATION (1-7)
 - Unit A. Federal and State Laws Relating to Vocational Education (1)
 - Unit B. Framework of Federal, State, and Local Administrative Agencies (1)
 - Unit C. Federal, State, and Local Policies and Plans for Vocational Education (1)
 - Unit D. Local Administration of Vocational Education (1)
 - Unit E. Labor Laws and Labor Relations Affecting Education (1)
 - Unit F. Vocational Training for War and Postwar Eras (1)
 - Unit G. Problems in Vocational Rehabilitation of the Physically Handicapped (1)
- 460S. PROBLEMS IN VOCATIONAL REHABILITATION OF THE HANDICAPPED (1-6)
 - Unit A. The Counseling Interview in Vocational Rehabilitation (1-3)
 - Unit B. Occupational Information and Placement Techniques in Vocational Rehabilitation (1-3)

INDUSTRIAL ENGINEERING

PROFESSOR CLARENCE E. BULLINGER, I.E., M.S.

Head of the Department

501. MANUFACTURING METHODS (2-8) Special projects including investigation; experimentation, design, and research of some one or more special types of manufacture. *Professor Bullinger*

502. MANAGEMENT METHODS (3-6) Intensive study of newer phases of scientific management, including production control and application of Gantt charts; research on special problems. *Professor Bullinger*

INDUSTRIAL ENGINEERING

503. PERSONNEL RELATIONS (2-8) Research on special topics. *Professor Bullinger*
505. GRAPHICAL COMPUTATION (2-10) Construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. *Professor Bullinger*
506. TIME AND MOTION STUDY (3-9) Machine data, elementary and fundamental machine times; determination of fatigue curves; design of Barth slide rules, micro-motion study and chart plotting of micromotion results; chronocyclegraph study. *Professor Anderson*
507. BUDGETARY CONTROL AND STANDARD COSTS (3-6) Divisional budgets as control media; establishing standard cost data, standard cost accounting procedures, and use of cost variances in controlling manufacturing operations. Prerequisite: I.E. 401. *Professor Hussey*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. INDUSTRIAL ACCOUNTS (4) *Professors Caldwell, Hussey, and Watmough*
404. SCIENTIFIC MANAGEMENT (2) *Professors Bullinger, Caldwell, and Roscoe*
406. FACTORY PLANNING (2) *Professors Bauer and Thuring*
409. PERSONNEL ADMINISTRATION (3) *Professors Farwell and Thomas*
- 422a,b,c,d,e,f, 422a,b,c,d,e,fX. INDUSTRIAL ENGINEERING PROBLEMS (2-12)
Professors Bullinger, Anderson, Hussey, Thomas, Niebel, and Thuring
423. QUALITY CONTROL (2-3) *Professor Bullinger, Mr. Ekey*
424. JOB EVALUATION (3) *Professor Thomas*
- 425, 425X. METHODS OF INDUSTRIAL OPERATIONS RESEARCH (3) *Professor Bullinger*
429. PLASTIC WORKING OF METALS (3) *Professor Roscoe*
- 430, 430X. INDUSTRIAL LEADERSHIP (3) *Professor Caldwell*

INSTITUTION ADMINISTRATION

PROFESSOR ESTHER A. ATKINSON, M.S.

Head of the Department of Hotel and Institution Administration

502. PROBLEMS IN INSTITUTIONAL ADMINISTRATION (3-6) Individual study of problems in institutional administration. Prerequisites: In.Adm. 326, 330. *Professor Atkinson*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

410. TEA ROOM MANAGEMENT (3)
- 437a,b,cS. SCHOOL CAFETERIA PROBLEMS (1-3) Units A, B, C, 1 credit per unit.
438. SCHOOL LUNCH ADMINISTRATION (3)
461. INSTITUTION ADMINISTRATION (3)
462. INSTITUTION EXPERIENCE (3)

INTERNATIONAL UNDERSTANDING

Consult PROFESSOR WILLIAM H. GRAY, M.A., Ph.D.

The following course may be taken for graduate credit under the restrictions in force:

400S. WORLD AFFAIRS AND INTERNATIONAL UNDERSTANDING (3)

ITALIAN

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Head of the Department of Romance Languages

571. SEMINAR IN ITALIAN LITERATURE (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

JOURNALISM

PROFESSOR FRANKLIN C. BANNER, M.A.

Head of the Department

504. SEMINAR IN PENNSYLVANIA PRESS HISTORY (3)

505. INTERNATIONAL PRESS PROBLEMS (3-6) Legal and communications problems of the international flow of news and opinion; international press codes.

506. SEMINAR IN COMMUNICATIONS RESEARCH METHODS (3-6) Social science measuring techniques for readership and advertising studies, media effectiveness, and propaganda results.

513. NEWSROOM POLICIES (3) Case study of news desk ethics and news values; their impact on news story presentation.

568. SEMINAR IN LEGAL PROBLEMS IN FREEDOM OF THE PRESS (3-6)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. THE PRESS, ITS CRITICS AND ETHICS (3)

416. ADVANCED COPY READING (3)

424. ADVANCED REPORTING (3)

430. SUPERVISION AND MANAGEMENT OF SCHOOL PUBLICATIONS (3)

441. ADVANCED ADVERTISING COPYWRITING (3)

480. PROBLEMS OF PUBLISHING (3)

LATIN

PROFESSOR ROBERT E. DENGLE, A.M., Ph.D.

Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

500. LATIN LITERATURE (3) Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures.

Professor Dengler

501. ROMAN RELIGION AND PHILOSOPHY (3) Development of religious concepts at Rome from primitive Italic origins to the advanced forms that culminated in Roman Stoicism.

Professor Krauss

502. LATIN EPIGRAPHY (3) Lectures and readings on Roman inscriptions; illustrative exercises.

Professor Krauss

503. LATIN PALEOGRAPHY (3) The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises.

Professor Dengler

504. ROMAN TOPOGRAPHY (3) Physical development of the city of Rome, its walls, aqueducts, bridges, streets, fora, public buildings, temples, etc.; building materials and methods of construction.

Professor Krauss

510. LATIN SEMINAR (3)

518. LATIN RESEARCH (1-3) Prosecution of an assigned problem under the guidance of a member of the department.

Professor Dengler

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

428. LUCRETIVS (3)

Professor Krauss

429. QUINTILIAN (3)

Professor Krauss

431. JUVENAL (3)

Professor Krauss

436S. FUNCTIONAL PROBLEMS IN LATIN (3)

440a,b,c,dS. COLLEGE LATIN (3-12)

Professor Dengler

LIBRARY SCIENCE

Consult LIBRARIAN RALPH W. McCOMB, M.A.

The following courses may be taken for graduate credit under the restrictions in force:

403S. INTERMEDIATE DICTIONARY CATALOGING AND SUBJECT HEADINGS (2-3)

405S. INTERMEDIATE REFERENCE WORK AND BIBLIOGRAPHY (2-3)

407S. SPECIAL PROBLEMS IN SCHOOL LIBRARY SERVICE (6)

MATHEMATICS

PROFESSOR ORRIN FRINK, JR., M.A., Ph.D.

Head of the Department

500. ANALYTICAL MECHANICS (3) An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math. 419 or Phys. 461.
- 501-502. THEORY OF FUNCTIONS OF A REAL VARIABLE (3 each) Theory of real functions, sets, measure, derivatives, and integrals. Prerequisite: Math. 420.
503. FOURIER SERIES AND HARMONIC FUNCTIONS (3) Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisites: Math. 90, 420.
505. INTEGRAL EQUATIONS (3) Fredholm and Volterra equations, and applications. Prerequisite: Math. 421.
507. CALCULUS OF VARIATIONS (3) Prerequisites: Math. 90, 421.
- 508-509. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (3 each) Development of the complex number system; theory of analytic functions. Prerequisite: Math. 421.
510. THEORY OF GROUPS (3) General properties of groups with applications. Prerequisite: Math. 471 or 535.
511. LINEAR ALGEBRA AND MATRIX THEORY (3) Vector spaces and linear transformations, canonical representations, elementary divisors and invariant factors. Prerequisite: Math. 481.
- 513-514. ADVANCED ANALYTIC GEOMETRY (3 each) Introduction of homogeneous co-ordinates and their use in the study of projective properties. Prerequisite: Math. 30.
- 520-521. PROJECTIVE GEOMETRY (3 each) General study of the subject from the postulational standpoint. Prerequisite: Math. 30. Alternate years or as required.
- 522-523. METRIC DIFFERENTIAL GEOMETRY (3 each) The usual classical treatment of the subject. Prerequisite: Math. 11 or 30.
- 530-531. TOPOLOGY (3 each) Topological spaces, combinatorial topology, applications to algebra and analysis.
534. THEORY OF ALGEBRAIC NUMBERS (3) Introduction to the number theory of quadratic fields, with study of the theory of ideals in quadratic and higher fields, with application. Prerequisites: Math. 404, 471.
- 535-536. MODERN ALGEBRAIC THEORIES (3 each) Groups, rings, ideals, algebraic number fields, Galois theory. Prerequisite: Math. 471.
- 542-543. THEORY OF STATISTICS (3 each) Univariate and multivariate distributions, sampling distributions, theory of estimation, statistical hypotheses. Prerequisites: Math. 409, 421.
- 550-551. MATHEMATICAL LOGIC (3 each) The logical basis of mathematics and its ultimate nature. Prerequisite: Math. 471 or Phil. 428.

- 552-553. NUMERICAL METHODS (3 each) Procedures for practical calculation, including interpolation, solution of equations, iterative methods, harmonic analysis and use of modern calculating equipment. Prerequisite: Math. 420.
- 560-561. THEORY OF DIFFERENTIAL EQUATIONS (3 each) Prerequisites: Math. 90, 421.
570. SPECIAL TOPICS IN GEOMETRY (3-6)
571. SPECIAL TOPICS IN ANALYSIS (3-6)
572. SPECIAL TOPICS IN ALGEBRA (3-6)
573. SPECIAL TOPICS IN APPLIED MATHEMATICS (3-6)
574. SPECIAL TOPICS IN FOUNDATIONS OF MATHEMATICS (3-6)
- 575-576. MATHEMATICS SEMINAR (1-6 each) Selected topics from recent mathematical developments.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

403. MODERN METHODS IN GEOMETRY (3)
404. THEORY OF NUMBERS (3)
405. PARTIAL DIFFERENTIAL EQUATIONS (3)
407. FOUNDATIONS OF ALGEBRA AND GEOMETRY (3)
408. APPLICATIONS OF MATHEMATICS (3)
- 409, 409X. THEORY OF PROBABILITY (3)
410. STATISTICAL METHODS (3)
411. FINITE DIFFERENCES (3)
417. VECTOR ANALYSIS (3)
419. ANALYTICAL MECHANICS (3)
- 420-421. ADVANCED CALCULUS (3 each)
424. LEAST SQUARES (2)
425. CURVE FITTING (1)
431. DIFFERENTIAL EQUATIONS (3)
441. THEORY OF EQUATIONS (3)
- 451-452. INTRODUCTION TO APPLIED MATHEMATICS (3-6 each)
471. FOUNDATIONS OF ALGEBRA (3)
472. FOUNDATIONS OF GEOMETRY (3)
481. VECTORS AND MATRICES (3)

MECHANICAL ENGINEERING

PROFESSOR NORMAN R. SPARKS, M.E.

Head of the Department

502. ADVANCED GAS TURBINES (3-6) Thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.

MECHANICAL ENGINEERING

504. ADVANCED THERMODYNAMICS (3-6) Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisite: M.E. 3 or 104.
505. HEAT TRANSMISSION (3-6) Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412.
506. MECHANICAL ENGINEERING SEMINAR (1-4) Advanced courses adapted to the individual requirements of graduates in mechanical engineering.
507. ADVANCED INTERNAL COMBUSTION ENGINES (3) Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504.
510. FUEL INJECTION AND COMBUSTION IN DIESEL ENGINES (3-6) Characteristics and efficiency of various injection systems.
511. FUEL SPRAY LABORATORY (3) Laboratory study of fuel injection for the Diesel engine.
512. SCAVENGING OF TWO-STROKE CYCLE ENGINES (3) Design of ports, valves, blowers, intake and exhaust manifolds for proper scavenging and charging of engines, particularly two-stroke cycle Diesel engines; experimental technique in evaluating scavenging. Prerequisite: M.E. 413.
513. FUEL FEEDING DEVICES FOR INTERNAL COMBUSTION ENGINES (3) Carburetors and injection equipment for Otto and Diesel engines and for liquid-fuel turbines, including the required control devices.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401a,b,c,d. MECHANICAL ENGINEERING (3-12)
402. AIR CONDITIONING (3)
408. STEAM TURBINES (3)
409. GAS TURBINES (3)
410. STEAM POWER PLANTS (3)
- 411, 411X. REFRIGERATION (3)
- 412, 412X. FUNDAMENTALS OF HEAT TRANSFER (3)
413. INTERNAL COMBUSTION ENGINES (3)
416. RESISTANCE AND POWERING OF SHIPS (3)
417. THEORY OF ENGINEERING INSTRUMENTS (3)

MACHINE DESIGN

Consult PROFESSOR MAURICE S. GJESDAHL, M.S.

502. FRICTION AND LUBRICATION (3) The hydrodynamic theory of lubrication and methods of applying it to bearing design, together with a survey of methods of testing lubricants.

505. ADVANCED DYNAMICS OF MACHINES (3-6) Linear and torsional vibrations in and balancing of rotating and reciprocating machinery; exact analysis of stresses produced by these and other dynamic forces in machine parts. Prerequisites: Mchs. 12, M.E.Des. 8.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

402. DESIGN OF MACHINE TOOLS (3)
403. ADVANCED MACHINE DESIGN PROBLEMS (3)
404. MACHINE DESIGN ANALYSIS (3)

MECHANICAL ENGINEERING LABORATORY

Consult PROFESSOR EDGAR E. AMBROSIUS, M.S.

501. INVESTIGATION PROJECTS (2-6) Special experimental studies or investigations in mechanical engineering, adapted to individual requirements.

METALLURGY

PROFESSOR AMOS J. SHALER, Sc.D.

Chief of the Division

501. METALLURGICAL PROBLEMS (1-6 per semester) Independent study of special problems in metallurgy. Prerequisites: Met. 411, 413.
502. METALLURGICAL SEMINAR (1 per semester) Conferences, reading, and reports. Required of all graduate students in metallurgy. *Professor Shaler*
515. CORROSION OF METALS (3) Phenomena and theories of metallic corrosion; principles of alloy selection for engineering and structural uses in corrosive environments. Prerequisites: Met. 411, 413. *Professor Read*
516. MECHANICAL METALLURGY (3) Theories of plastic flow in polycrystalline metals; calculations of simple and combined stresses and application to metal forming and mechanical tests. Prerequisites: Met. 411, 413. *Professor Shaler*
517. ADVANCED NONFERROUS METALLURGY (3) Theory of electrorefining, electro-winning, and processes involving the vapor phase; physical chemistry of roasting and leaching. Prerequisites: Met. 411, 413. *Professor Read*
518. CONSTITUTION OF METALLURGICAL SYSTEMS (3) Application of thermodynamic principles to study of heterogeneous equilibrium in alloy, slag, and slag-metal systems. Prerequisites: Met. 411, 413. *Professor Davis*
519. ADVANCED FERROUS METALLURGY (3) Physicochemical principles in the smelting and refining of iron and steel; slag control; solidification and primary forging of steel. Prerequisites: Met. 411, 413. *Professor Davis*

METALLURGY

520. FOUNDRY METALLURGY (3) Principles of foundry metallurgy; application to foundry operations for various ferrous and nonferrous casting alloys. Prerequisites: Met. 411, 413. *Professor Lindsay*
521. ENGINEERING ALLOYS (3) Requirements and applications of industrial alloys; mechanical, thermal, electrical, and magnetic properties. Prerequisites: Met. 411, 413. *Professor Lindsay*
522. SOLID PHASE REACTIONS IN METALS (3) Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitations from solid solution, eutectoid decomposition and order-disorder phenomena. Prerequisites: Met. 411, 413. *Professor Lindsay*
523. BEHAVIOR OF METAL CRYSTALS (3) Plastic action in single crystals of metals and in polycrystalline metals, theoretical crystal plasticity, recovery, and recrystallization, deformation and recrystallization textures, anisotropy in general. Prerequisites: Met. 411, 413. *Professor Zackay*
525. METAL FINISHING (3) Metallic coatings and their metallurgical properties; theories and problems of application, utilization, and evaluation. Prerequisites: Met. 411, 413. *Professor Read*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

405. FERROUS METALLOGRAPHY (3)
406. NONFERROUS METALLOGRAPHY (3)
407. METALLURGICAL ENGINEERING I (3)
408. METALLURGICAL ENGINEERING II (3)
409. METALLURGICAL INVESTIGATIONS I (3)
410. METALLURGICAL INVESTIGATIONS II (3)
411. ADVANCED PHYSICAL METALLURGY (3)
412. EXPERIMENTAL METALLURGY (3)
413. ADVANCED CHEMICAL METALLURGY (3)

METEOROLOGY

PROFESSOR HANS NEUBERGER, D.Sc.

Chief of the Division

500. METEOROLOGICAL SEMINAR (1-3) Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteo. 421, 441, 451.
501. METEOROLOGICAL RESEARCH (1-15) Research work in physical, synoptic, dynamic meteorology; climatology. Prerequisites: a minimum of one year of physics, calculus, and differential equations, 15 credits in meteorology.
502. SELECTED TOPICS OF ADVANCED METEOROLOGY (2) Current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology.
504. THEORETICAL AND DYNAMIC METEOROLOGY (3) Mathematical analysis of meteorological phenomena. Prerequisite: Meteo. 452.

505. BIOCLIMATOLOGY (2) Climatic phenomena in their relation to life. Prerequisite: Meteo. 372.
506. ADVANCED METEOROLOGICAL ANALYSIS (2-6) Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteo. 421.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

421. SYNOPTIC METEOROLOGY I (3)
422. SYNOPTIC METEOROLOGY II (3)
431. SYNOPTIC METEOROLOGY LABORATORY I (2)
432. SYNOPTIC METEOROLOGY LABORATORY II (2-10)
441. PHYSICAL METEOROLOGY I (2)
442. PHYSICAL METEOROLOGY II (2)
450. APPLICATIONS OF STATISTICS TO METEOROLOGY (3)
451. DYNAMIC METEOROLOGY I (3)
452. DYNAMIC METEOROLOGY II (3)
453. PROBLEMS IN DYNAMIC METEOROLOGY (1)
492. METEOROLOGICAL SEMINAR (2)

MINERAL ECONOMICS

PROFESSOR JOHN D. RIDGE, S.M., Ph.D.

Chief of the Division

500. MARKETING OF MINERALS AND MINERAL PRODUCTS (3-6) Research in mineral marketing problems.
501. RESEARCH IN MINERAL ECONOMICS (3-6) Investigation in specialized fields of research in mineral economics.
502. TECHNOLOGIC INFLUENCES (3-9) Relationship of technologic advancements to financial development of the mineral industries.
505. PROBLEMS OF MINERAL ECONOMICS (3-12) Determination of basic technologic-economic patterns of selected mineral industries. Prerequisite: Min.Ec. 87.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. SEMINAR (1)
453. NONMETALLIC MINERALS (3)
463. MINERAL ECONOMY OF THE U.S.S.R. (3)
483. THE METALS AND THEIR ORES (3)
484. THE SOLID FUELS (3)
486. PETROLEUM AND NATURAL GAS ECONOMICS (3)
490. MINERAL VALUATION (3)
491. ANALYSIS OF MINERAL DATA (2)

MINERAL PREPARATION

MINERAL PREPARATION

PROFESSOR H. BEECHER CHARMBURY, M.S., Ph.D.

Chief of the Division

502. FROTH FLOTATION AND AGGLOMERATION (3) Intensive study of theory and applications of froth flotation and agglomeration. Prerequisite: Min.Pr. 405.
Professor Sun
504. MINERAL PREPARATION RESEARCH (3-10) Research work on specific problems in mineral preparation. Prerequisite: Min.Pr. 405 or 410.
Professor Charmbury and Staff
505. GRAVITY PROCESSES AND MISCELLANEOUS METHODS OF MINERAL PREPARATION (3) Intensive study of theory and applications of gravity, magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Min.Pr. 405.
Professor Mitchell
506. MINERAL PREPARATION PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Min.Pr. 405.
Professor Mitchell

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. MINERAL PREPARATION SEMINAR (1)
403. FLOWSHEETS OF MINERAL PREPARATION PLANTS (2)
404. PLANT LAYOUT AND DESIGN (3)
405. UNIT OPERATIONS (3)
406. MINERAL PREPARATION TESTING (2)
410. COAL PREPARATION (3)

MINERALOGY

PROFESSOR PAUL D. KRYNINE, Ph.D.

Chief of the Division

500. PHYSICAL MINERALOGY (3) Optical methods and measurement of optical constants of minerals.
Professors Krynine and Bates
- 501a. PETROLOGY (3-6) Microscopic study of rocks, emphasizing classification and genetic relationships.
Professors Krynine, Tuttle, and Griffiths
- *502a. MINERALOGICAL RESEARCH (3-18) Original study of some mineralogical problem, results of which may be applied on the thesis requirements.
504. THEORETICAL MINERALOGY (2) Selected topics in crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena; laboratory studies of identification techniques including X-ray diffraction. Prerequisite: Min. 461.
Professor Bates

* Credits to be arranged, 3-9 per semester.

505. MINERALOGY SEMINAR (1-2) Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students.

Professors Krynine, Tuttle, Bates, Griffiths, and Brindley

- †510. METAMORPHISM (2-6) Detailed review of chemical, mineralogical, and structural changes that take place during metamorphism. Prerequisite: Min. 483.

Professors Krynine, Tuttle, Bates, and Griffiths

511. BASIC SEDIMENTOLOGY (2-4) Composition, texture, structure, mass properties of sediments; dynamic processes in complex natural systems; sedimentary stages: weathering, erosion, transport, deposition, and lithification. Prerequisite: Min. 483. Concurrent: Min. 513.

Professor Krynine

512. BASIC SEDIMENTOLOGY, CONTINUED (2-4) Diastrophism and tectonic background of sedimentation; depositional loci; classification of sediments: quartzites, graywackes, arkoses; chemical sediments; paleogeography, paleoclimatology, oil finding. Prerequisite: Min. 511. Concurrent: Min. 514.

Professor Krynine

513. METHODS OF ANALYSIS OF SEDIMENTS (2) Principles and practices used in analyzing sedimentary rocks for size, shape, and accessory (heavy) minerals. Concurrent: Min. 511.

Professor Griffiths

514. APPLIED SEDIMENTOLOGY (2) Design and control in analysis of sedimentary rocks; application of these techniques to industrial problems. Concurrent: Min. 512.

Professor Griffiths

515. MINERALOGY OF CLAYS AND OTHER FINE-GRAINED MATERIALS (2-3) Physical and chemical properties of clay minerals; importance and application of X-ray diffraction, differential thermal analysis, light and electron microscopy. Prerequisite: Min. 460.

Professors Bates and Griffiths

516. PETROLOGY OF FINE-GRAINED SEDIMENTS (2-3) Fine-grained sedimentary rocks and their industrial applications. Prerequisite: Min. 515.

Professors Griffiths and Bates

- ‡517. EUROPEAN SEDIMENTS (1-6) Interpretative microscopic and hand specimen study of selected rock suites from Europe and Asia; correlation with paleogeographic and tectonic data. Prerequisites: Min. 512, 514.

Professor Krynine

- †518. AMERICAN SEDIMENTS (2-8) Thin section, heavy residue, textural and field data of arkoses, graywackes, quartzites, and carbonates from representative North American sedimentary provinces. Prerequisites: Min. 512, 514, 516.

Professor Krynine

- §519. OIL RESERVOIR PETROLOGY (2-6) Petrographic fundamentals controlling porosity, storage capacity, oil accumulation, effective permeability, fluid yield and retention, exploration and production methods. Prerequisites: Min. 512, 514, 516.

Professors Krynine and Griffiths

520. STUDY OF ACCESSORY MINERALS (2-4) Detailed study of accessory (heavy) minerals; their significance in problems of provenance, petrogenesis, mineral

† Credits to be arranged, 2-4 per semester.

‡ Credits to be arranged, 1-3 per semester.

§ Credits to be arranged, 2-3 per semester.

MINERALOGY

stratigraphy, and paleogeography. Prerequisites: Min. 511, 512, 513, 514.

Professor Griffiths

521. COLOR IN MINERALS (1-2) Nature of light absorption as a function of chemical composition for solutions, glasses, and minerals.

Professor Weyl

§522. THE ELECTRON MICROSCOPE IN MINERALOGICAL AND GEOLOGICAL PROBLEMS (2-6) Laboratory investigation of geological subjects at high magnification; correlation of data with those obtained by other methods of study.

Professor Bates

§523. X-RAY DIFFRACTION STUDIES OF MINERALS (2-6) Investigation of mineralogical problems with X-rays. Practicum includes preparation of samples, use of X-ray apparatus, and interpretation of patterns. Prerequisite: Min. 461.

Professors Bates and Brindley

524. INTRODUCTION TO SEDIMENTATION (1-2) Concurrent: Min. 483.

Professor Krynine

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

460. PHYSICAL MINERALOGY (3)

Professor Wright

461. DESCRIPTIVE MINERALOGY (4)

Professor Bates

483. PETROGRAPHY (4)

Professor Griffiths, Mr. Thornton

MINING

PROFESSOR ARNOLD W. ASMAN, B.Sc.

Chief of the Division

500. MINING SEMINAR (2) Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering.

501. MINE ENGINEERING (3) Mine mechanization problems. Selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488.

504. MINING RESEARCH (3-10 per semester) Research work on specific problems in physics of mining and mine mechanization. Prerequisite: Mng. 481.

506. MINE AND MINE PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499.

520. MINE PLANNING USING CYCLE STUDIES (3-6) Highly productive cycles of mine section operation are developed by use of time and method studies of the various sub-cycles involved. Prerequisite: Mng. 72.

521. MATHEMATICAL ANALYSIS OF MINE LAYOUTS (3) Proportioning layouts in regard to mineral available, distances, and centroids of mining areas; incremental and sub-cycle costs. Prerequisite: Mng. 488.

§ Credits to be arranged, 2-3 per semester.

522. **ROCK MECHANICS (3-6)** Detailed study of the physical properties of rocks as affecting the design of underground openings; testing procedures, calculations, and design. Prerequisite: Mng. 499.
523. **MINE DUSTS (3)** Detailed studies of methods of collecting, sampling, and determining amount, size, and mineral content of dust in mine atmospheres; methods of dust control. Prerequisite: Mng. 481.
524. **UNDERGROUND MINING POWER DISTRIBUTION SYSTEMS (3-6)** Calculations involved in the design of power applications and systems for mines; electrical, compressed air; Diesels; package power for extremely gassy conditions; sectionalizing; loads and load centers. Prerequisite: Mng. 488.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. **MINE SAFETY ENGINEERING (2)**
 481. **PHYSICS OF MINING (4)**
 484. **MINE COST CONTROL (2)**
 488. **ADVANCED MINE MECHANIZATION (3)**
 494. **MINE MANAGEMENT ENGINEERING (3)**
 499. **ADVANCED MINING DESIGN (2)**

MUSIC

PROFESSOR HUMMEL FISHBURN, M.A., Mus.D.

Head of the Department

- 503-506. **ADVANCED STRINGED INSTRUMENTS (3 per course)** Study, repertoire building, and recital performance. Prerequisite: Music 103-106. Fee \$25 per course.
Professor Karhan
- 511-514. **ADVANCED PIANO (3 per course)** Piano literature of all periods; stress laid on developing technique and preparing for public performance. Fee \$25 per course.
Professor Brinsmaid
- 531-534. **ADVANCED ORGAN (3 per course)** Study, repertoire building, and recital performance. Prerequisite: Music 31-34. Fee \$30 per course. *Professor Ceiga*
543. **MODERN HARMONY (3)** Harmonic writing based on 20th century practices with attention to traditional idioms that serve as foundation.
Professor Henninger
- 558-561. **FREE COMPOSITION (3 per course)** Composition; vocal and instrumental, standard or modern idioms. Prerequisite: 18 credits in harmony, counterpoint, and piano.
Professor Henninger
563. **FREE ARRANGING (3)** Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisite: 18 credits in harmony, including 3 of orchestration.
Professor Fishburn

MUSIC

567. THE LITERATURE OF THE ORCHESTRA (3) The suite, symphony, tone poem, and overture from the point of view of appreciation, form, and orchestration. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra. *Professor Fishburn*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

407. PIANO REPERTOIRE (3) *Professor Brinsmaid*
 408. VOCAL LITERATURE (3)
 410. MUSIC OF THE 20TH CENTURY (3)
 411. LITERATURE OF THE VIOLIN (3)
 429-432. SINGER'S STYLE AND INTERPRETATION (3 per course) Fee \$25 per course. *Professor Taylor*
 456. ELEMENTARY COUNTERPOINT (3) *Professor Henninger*
 466. ADVANCED CONDUCTING (3) *Professor Gullo*

MUSIC EDUCATION

PROFESSOR HUMMEL FISHBURN, M.A., Mus.D.

Head of the Department

500. MUSIC EDUCATION SEMINAR (3-6) Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems.
569. PRESENT-DAY TRENDS IN INSTRUMENTAL MUSIC (3) New methods and materials for band, orchestra, and ensembles.
571. VOCAL PEDAGOGY (3) Detailed study of vocal problems met in public schools, elementary through high school; vocal class pedagogy and literature; daily voice training. Prerequisites: Mus.Ed. 48, teaching experience.
572. INSTRUMENTAL PEDAGOGY (3-6) Research problems in band and orchestra. Prerequisite: Mus.Ed. 54 or practical experience.
573. THE MATERIALS OF APPRECIATION (3) Methods and materials for development of music appreciation in elementary and secondary schools. Prerequisites: Music 5, teaching experience.
- 574a,b. PRESENT-DAY TRENDS IN MUSIC EDUCATION (3-6) Present-day music education materials and methods (elementary and secondary levels) in relation to modern educational philosophy; emphasis upon practical problems presented by members of the class. Prerequisites: Mus.Ed. 48, teaching experience.
575. THE JUNIOR HIGH SCHOOL MUSIC CURRICULUM (3) Instructional materials, procedures, curricular and extracurricular activities, integration with other subjects.
576. MUSIC SUPERVISION (3) Current educational procedures in training music supervisors.

580. FIELD PROJECTS IN JUNIOR AND SENIOR HIGH SCHOOL MUSIC (3) Curricular problems to be carried on under actual school conditions; individual work under supervision. Prerequisites: teaching experience, 30 credits of graduate study.
594. PEDAGOGY OF EAR TRAINING (3) Materials and methods for training the listener to grasp, understand, and write what is heard from melody to four-part harmony. Prerequisite: 12 credits in ear training and/or harmony.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. MUSIC IN THE RURAL AREA (3)
 462. PEDAGOGY OF THEORY (3)
 468. THE TEACHING OF PIANO (3)
 469. BAND AND ORCHESTRA TECHNIQUE (3)
 470. CHORAL TECHNIQUE (3)
 475, 475X. OBJECTIVES AND PROBLEMS IN ELEMENTARY MUSIC EDUCATION (3)

PETROLEUM AND NATURAL GAS

PROFESSOR JOHN C. CALHOUN, M.S., Ph.D.

Chief of the Division

- 500a. PETROLEUM AND NATURAL GAS ENGINEERING RESEARCH (3-9 per semester)
501. ENERGETICS OF PETROLEUM ENGINEERING (3) Applications of thermodynamics to special problems in production of petroleum and natural gas. Prerequisite: M.E. 2.
- 502a. PETROLEUM AND NATURAL GAS ENGINEERING SEMINAR (3-9) Intensive study of one or several phases of petroleum engineering.
503. THE FLOW OF HOMOGENEOUS FLUIDS THROUGH POROUS MEDIA (3) Flow and pressure distributions for various geometric patterns for steady and unsteady states. Prerequisite: Math. 431.
504. WATER FLOODING (3-6) Continuation of Pet.E. 485 with emphasis on special problems. Prerequisite: Chem. 40.
506. ADVANCED PETROLEUM ENGINEERING (5) Advanced problems in petroleum and natural gas production. Prerequisites: Chem. 41, Pet.E. 310.
507. CONDENSATE FIELDS (2) Retrograde condensation phenomenon of hydrocarbon mixtures at high pressures; literature on condensate fields; production methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: Pet.E. 501.
508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Principles of colloidal activity applied to control of properties of clay slips, drilling fluids, and similar suspensions. (In co-operation with the Ceramics staff.) Prerequisite: Chem. 41.

Professor Henry

PETROLEUM AND NATURAL GAS

509. ADVANCED PETROLEUM ENGINEERING DESIGN (2) Continuation of Pet.E. 320. Projects in selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: Pet.E. 320.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

420. EXPLOITATION AND DEVELOPMENT ENGINEERING (3)
481. NATURAL GAS AND GASOLINE PLANTS (4)
483. NATURAL GAS LABORATORY (1)
485. SECONDARY RECOVERY (3)
490. ADVANCED CORE TESTING (3)

PHILOSOPHY

PROFESSOR JOHN M. ANDERSON, M.A., Ph.D.

Head of the Department

- 500a,b. ETHICAL SEMINAR (2-6) Critical study of some phase of ethical fact and theory.
501a,b,c,d. PHILOSOPHY SEMINAR (2-12) Meets the demand for advanced study in special fields of philosophical thought.
503. LOGIC (3) The logical basis of mathematics and its ultimate nature.
504. SOCIAL AND POLITICAL PHILOSOPHY (3) Critical study of basic problems in their historical and functional setting.
505. IDEALS OF WESTERN CIVILIZATION (3) Analysis of contemporary ideals in terms of their Graeco-Judean bases.
507. SEMINAR IN HISTORY OF PHILOSOPHY (3-12) Concentrated study of some work or problem in the history of philosophy.
510. CLASSICS OF SCIENTIFIC METHOD (3) Actual reasoning and procedures of historical masters of scientific methods.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. RELIGIOUS PHILOSOPHY OF THE GREAT REFORMERS (3)
404X. ADVANCED HISTORY OF PHILOSOPHY (3)
405. PHILOSOPHY OF ST. AUGUSTINE (3)
409. PHILOSOPHY OF ST. THOMAS AQUINAS (3)
415. THE PHILOSOPHY OF KANT (3)
418. RECENT AND CONTEMPORARY PHILOSOPHY (3)
426. METAPHYSICS (3)
427. ADVANCED ETHICS (3)
428. ADVANCED LOGIC (3)
429. SEMANTICS: PHILOSOPHY OF LANGUAGE AND SYMBOLISM (3)
430. PHILOSOPHICAL PROBLEMS (3-6)

PHYSICAL EDUCATION

PROFESSOR JOHN D. LAWTHER, M.A., D.Pd.

Assistant Dean of the School of Physical Education and Athletics

500. PROBLEM IN PHYSICAL EDUCATION (3) Prerequisite: Ph.Ed. 455.
522. ORGANIZATION AND ADMINISTRATION OF PHYSICAL EDUCATION IN COLLEGES AND UNIVERSITIES (3) Administration of physical education in college; credits, schedules, excuses, records, reports, budgets, classification, tests, staff, and facilities. Prerequisite: Ph.Ed. 491. *Professor Bedenk*
523. ADMINISTRATION OF COLLEGE ATHLETICS (3) Eligibility, schedules, managerial systems, relationships of athletics to the physical education program and to education in general. Prerequisite: Ph.Ed. 491. *Professor Bedenk*
526. ATHLETIC PROBLEMS IN SCHOOLS (3) Practical problems which result from administration of athletics in schools. Reports on some aspects of athletics required. Prerequisite: Ph.Ed. 460. *Professor Bedenk*
528. PROFESSIONAL EDUCATION OF TEACHERS OF HEALTH AND PHYSICAL EDUCATION (3) Health and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems. Prerequisite: Ph.Ed. 491. *Professor Jones*
529. SUPERVISION OF PHYSICAL EDUCATION IN SCHOOLS (3) Methods and policies of the school supervisor of physical education; conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher. Prerequisite: Ph.Ed. 491. *Professor Jones*
530. RESEARCH TECHNIQUES IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Ph.Ed. 490. *Professor Lawther*
531. RESEARCH IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Ph.Ed. 530. *Professor Gross*
532. TESTS AND MEASUREMENTS IN PHYSICAL EDUCATION (3) Critical study of tests and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Ph.Ed. 490. *Professor Gross*
534. STUDIES IN CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION (3) Principles and methods of curriculum building in physical education; different psychological and educational points of view, organizing a course of study committee, making units of instruction. Prerequisite: Ph.Ed. 454. *Professor Jones*
535. MODERN FOREIGN SYSTEMS OF PHYSICAL EDUCATION (3) Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Ph.Ed. 534, 595. *Professor Speidel*
536. SCIENTIFIC METHODS IN ATHLETIC COACHING (3) Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Ph.Ed. 460. *Professor Lawther*

PHYSICAL EDUCATION

550. SEMINAR IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (1-6)
Open only to students preparing approved theses and dissertations.
Professor Lawther and Staff
555. RELATIONSHIPS OF PHYSICAL EDUCATION TO THE EXACT SCIENCES (3)
Professor Lucey
560. ADMINISTRATIVE PROBLEMS OF PHYSICAL EDUCATION IN SCHOOLS (3) Solutions to problems emerging from the administration of physical education in schools, fitting physical education into the school's schedule, awards and budgets. Prerequisite: Ph.Ed. 491.
Professor Jones
581. PROBLEMS IN BODY MECHANICS (3) Certain aspects of human motion and body segmental alignment; analysis of human gait, and the dynamic adaptation of the spine, thorax, and pelvis to external physical forces. Prerequisite: Hl.Ed. 244, Ph.Ed. 399.
Professor Lucey
595. PHILOSOPHY OF HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3)
Prerequisite: Hl.Ed. 453 or Ph.Ed. 491 or Recr. 465.
Professor Jones

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

424. MODERN TRENDS IN HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS (3)
Professor Thiel
- 429S. THE MODERN DANCE IN EDUCATION (3)
Professor Briant
- 431S. COACHING OF ADVANCED BASEBALL (3)
Professor Bedenk
- 436S. COACHING OF ADVANCED FOOTBALL (3)
Professor Engle
- 437S. COACHING OF ADVANCED BASKETBALL (3)
Professor Gross
- 438S. COACHING OF ADVANCED TRACK (3)
Professor Werner
- 439S. COACHING OF ADVANCED SOCCER (3)
Professor Werner
- 440S. COACHING OF ADVANCED GYMNASTICS (3)
Professor Wettstone
- 441S. ADVANCED COACHING OF ATHLETICS FOR MEN (1-11)
- Unit A. Basketball (1) *Professor Gross*
 - Unit B. Football (1) *Professor Engle*
 - Unit C. Track and Field (1) *Professor Werner*
 - Unit D. Baseball (1) *Professor Bedenk*
 - Unit E. Wrestling (1) *Professor Speidel*
 - Unit F. Soccer (1) *Professor Gross*
 - Unit G. Swimming (1) *Professor Gutteron*
 - Unit H. Gymnastics (1) *Professor Wettstone*
 - Unit I. Boxing (1) *Mr. Sulkowski*
 - Unit J. Lacrosse (1) *Professor Thiel*
 - Unit K. Fencing (1) *Professor Meyer*
- 449S. ADVANCED TEACHING OF SPORTS AND RHYTHMICS (1-11)
- Unit A. Soccer and Speedball (1) *Professor Lucey*
 - Unit B. Basketball (1) *Professor Lucey*
 - Unit C. Field Hockey (1) *Professor Lucey*
 - Unit D. Archery (1) *Professor Haidt*
 - Unit E. Swimming (1) *Professor Bleich*
 - Unit F. Rhythmics for Children (1) *Professor Briant*
 - Unit G. Modern Dance and Accompaniment (1) *Professor Briant*
 - Unit H. Early American Country Dancing and Social Dancing (1) *Professor Briant*

PHYSICAL EDUCATION

- Unit I. Tennis (1)* *Professor Lucey*
Unit J. Badminton (1) *Professor Lucey*
Unit K. Golf (1) *Mr. Rutherford*
 452S, 452X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE ELEMENTARY SCHOOL (3) *Professor Speidel*
 453S, 453X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE HIGH SCHOOL (3) *Professor Bischoff*
 454. THE NATURAL PROGRAM OF PHYSICAL EDUCATION ACTIVITIES, APPLIED (3) *Professor Bischoff*
 455. SCIENTIFIC METHOD IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Gross*
 460. METHODS AND PRINCIPLES OF ATHLETIC COACHING (3) *Professor Lawther*
 466S. VISUAL INSTRUCTION IN ATHLETICS (3) *Professor Conger*
 471S. HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS FOR THE SCHOOL ADMINISTRATOR (3) *Professor Lawther and Staff*
Unit A. Athletics in the Schools (1)
Unit B. Health Education in the Schools (1)
Unit C. Physical Education and Recreation in the Schools (1)
 480. ADVANCED ANATOMY AND PHYSIOLOGY, APPLIED (3) *Professor Lucey*
 482, 482X. POSTURE EDUCATION IN THE SCHOOLS (3) *Miss Phillips*
 488S. THE ADMINISTRATION OF PHYSICAL EDUCATION AND ATHLETICS FOR WOMEN (3) *Professor Haidt*
 489. INTRAMURAL ATHLETICS (3) *Professor Bischoff*
 490. INTRODUCTION TO TESTS AND MEASUREMENTS IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Gross*
 491. ORGANIZATION AND ADMINISTRATION OF HEALTH AND PHYSICAL EDUCATION IN SCHOOLS (3) *Professor Jones*

PHYSICS

PROFESSOR JOHN A. SAUER, M.S., Ph.D.
Head of the Department

507. THEORETICAL THERMODYNAMICS (3) Mathematical treatment of the principles of thermodynamics.
 509. PHYSICS SEMINAR (1) Selected topics from current physical research critically examined and discussed. May be continued in successive semesters as Phys. 509a, 509b, 509c.
 517. KINETIC THEORY (3) The Maxwell-Boltzmann law, Brownian movements, specific heats, and other selected topics. Prerequisites: Phys. 411, Math. 431.
 521. CRYSTAL STRUCTURE (3) Solution of the structure of crystals by X-ray methods. Available for major credit in either physics or chemistry. Prerequisite: Chem. 440 or Min. 460 or Phys. 461.
 522. ADVANCED CRYSTAL ANALYSIS (3) Continuation of Phys. 521, including the application of crystal structure studies to physical, chemical, and metallurgical problems. Available for major credit in either physics or chemistry.

PHYSICS

- 530-531. THEORETICAL PHYSICS (3 each) Application of higher mathematics to problems in various fields of physics. Prerequisite: Phys. 411 or 467.
533. THEORY OF SOUND (3) Mathematical treatment of the theory of sound. Prerequisite: Phys. 530.
553. NUCLEAR PHYSICS (3) Mathematical course in nuclear physics. Prerequisite: Phys. 562.
- 557-558. ELECTRICITY AND MAGNETISM (3 each) Treatment of the mathematical theory of electricity and magnetism. Prerequisite: Phys. 531.
560. ADVANCED PHYSICAL MEASUREMENTS (1-18) Offers opportunity for advanced work in various fields of physics.
561. DE BROGLIE WAVES AND QUANTUM MECHANICS (3) Introduction to modern interpretation of atomic structure and radiation phenomena, based upon the de Broglie and Schroedinger wave theory. Prerequisite: Phys. 531.
562. WAVE MECHANICS IN MODERN PHYSICS (3) Continuation of Phys. 561. Theory of atomic and simple molecular spectra, Zeeman and Stark effect, theories of metallic conductivity and thermionic emission, etc. Prerequisite: Phys. 561.
571. ATOMIC STRUCTURE (3) Recent work in atomic and subatomic physics.
572. SPECTROSCOPY (3) Atomic and molecular spectra, both emission and absorption methods of excitation, radiation and ionization potentials, spectral series, fine structure, spectra of ionized and stripped atoms.
575. PROBLEMS IN MODERN PHYSICS (1-3) Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 456.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. INTERMEDIATE ELECTRICITY AND MAGNETISM (4)
402. ELECTRONICS (4)
404. ELECTRONIC MEASUREMENTS (2-4)
411. THEORETICAL MECHANICS (3)
417. THE TEACHING OF PHYSICS (3)
420. INTERMEDIATE HEAT (3)
- 433S. INTERMEDIATE MECHANICS AND FLUID PHYSICS (3)
- 435S. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
- 437S. INTERMEDIATE HEAT, SOUND, AND LIGHT (3)
- 439S. ELEMENTARY SURVEY OF MODERN PHYSICS (3)
- 441S. DEMONSTRATION EQUIPMENT (3)
443. INTERMEDIATE ACOUSTICS (3)
444. MEASUREMENTS IN ACOUSTICS (2)
- 454, 454X. ATOMIC AND NUCLEAR PHYSICS (3)
456. ATOMIC AND NUCLEAR PHYSICS (3)
457. EXPERIMENTAL ATOMIC PHYSICS (2)
458. INTERMEDIATE OPTICS (4)
461. THEORETICAL MECHANICS (3)
467. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
- 473-474. BIOPHYSICS (3 each)
477. X-RAY ANALYSIS OF SOLIDS AND LIQUIDS (3)

POLITICAL SCIENCE

PROFESSOR R. WALLACE BREWSTER, M.A., Ph.D.

Head of the Department

- 500. SEMINAR IN POLITICAL SCIENCE (3-12) Subject to be announced.
- 505. SEMINAR IN ADVANCED AMERICAN GOVERNMENT (3-12)
- 508. RESEARCH IN PUBLIC ADMINISTRATION (3-12)
- 509. RESEARCH TECHNIQUES IN POLITICAL SCIENCE (3)
- 510. POLITICAL AND ADMINISTRATIVE PROBLEMS IN PENNSYLVANIA (3-6)
- 512. COMPARATIVE GOVERNMENT (3-12)
- 515. INTERNATIONAL RELATIONS (3-6)
- 517. INTERNATIONAL ORGANIZATION (3-6)
- 519. PUBLIC ADMINISTRATION (3-6)
- 521. POLITICAL THEORY (3-6)
- 535. GOVERNMENT REGULATION (3-6)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 411. AMERICAN POLITICAL THEORY (3)
- 413. GOVERNMENT AND POLITICS OF THE SOVIET UNION (3)
- 414. FOREIGN POLICY OF THE SOVIET UNION (3)
- 415. INTERNATIONAL ORGANIZATION (3)
- 416. INTERNATIONAL LAW (3)
- 417. MUNICIPAL GOVERNMENT (3)
- 419. PUBLIC ADMINISTRATION (3)
- 421. MODERN POLITICAL THEORIES (3)
- 424S. STATE GOVERNMENT IN THE UNITED STATES (3)
- 427. PUBLIC OPINION AND PROPAGANDA (3)
- 428. PENNSYLVANIA LOCAL GOVERNMENT (3)
- 429. PENNSYLVANIA LOCAL ADMINISTRATION (3)
- 431. ANCIENT AND MEDIEVAL POLITICAL THEORIES (3)
- 432. CURRENT POLITICAL TRENDS AND PROBLEMS IN THE UNITED STATES (3-9)
- 433. LABOR AND WELFARE LEGISLATION AND ADMINISTRATIVE PROBLEMS (3)
- 435. GOVERNMENT HOUSING, PLANNING, AND PUBLIC WORKS (3)
- 442. AMERICAN FOREIGN POLICY (3)
- 444. GOVERNMENT REGULATION (3)
- 445. ADMINISTRATIVE LAW (3)
- 446. JUDICIAL SYSTEMS (3)
- 450. GOVERNMENT AND FOREIGN POLICIES OF BRITAIN AND THE COMMONWEALTH (3)
- 456. GOVERNMENTS AND FOREIGN POLICIES OF LATIN AMERICA (3)
- 458. GOVERNMENTS AND FOREIGN POLICIES OF THE FAR EAST (3)
- 499X. FOREIGN STUDY IN GOVERNMENT (2-6)

PORTUGUESE

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Head of the Department of Romance Languages

- 571. SEMINAR IN PORTUGUESE LITERATURE (3-6) Prerequisite: Port. 4.

POULTRY HUSBANDRY

PROFESSOR ERNEST W. CALLENBACH, M.S.

Head of the Department

502. ADVANCED POULTRY NUTRITION (2-4) Prerequisite: P.H. 3. *Professor Murphy*
503. ADVANCED POULTRY FARM MANAGEMENT (2-4) Prerequisite: P.H. 8.
Professor Bressler
504. ADVANCED MARKET POULTRY AND EGGS (2-4) Prerequisites: P.H. 1, 7; Agr.Ec.
33 or 2 additional credits in poultry husbandry. *Professor Margolf*
505. RESEARCH IN POULTRY HUSBANDRY (1-15 per semester) Prerequisite: 9 credits
in poultry husbandry. *Professor Callenbach and Staff*
506. SEMINAR IN POULTRY HUSBANDRY (1-6) *Professor Callenbach and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. (Psy. 401). ANIMAL BEHAVIOR (3)

412. POULTRY BREEDING (3)

Professor Maw

PSYCHOLOGY

PROFESSOR CLARENCE R. CARPENTER, M.A., Ph.D.

Head of the Department

500. SEMINAR: INTRODUCTION TO RESEARCH METHODS (1) Prerequisite: 12 credits
in psychology.
501. ADVANCED PSYCHOLOGY (3) Comprehensive study of general psychology.
Prerequisite: 9 credits in psychology. *Professor Lepley*
502. ADVANCED EDUCATIONAL PSYCHOLOGY (2-4) Psychological theories and principles underlying educational theories and practices. Prerequisites: Psy. 14 or 414; Ed. 31 or teaching experience. *Professor van Ormer*
503. PHYSIOLOGICAL PSYCHOLOGY (2-6) Correlations between structure and function of nervous system and human consciousness; laws and theories in fields of sensation, attention, association, affection, and thought. Prerequisite: 9 credits in psychology. *Professor DeCamp*
504. COMPARATIVE PSYCHOLOGY (2-4) Behavior from standpoint of phylogenetic growth and development; biological implications; comparison of different types of animals, including man. Prerequisite: 9 credits in psychology. *Professor Hale*
505. RESEARCH PROBLEMS IN PSYCHOLOGY (1-15) Prerequisite: 12 credits in psychology.
509. ADVANCED THEORY OF LEARNING AND HABIT FORMATION (2-3) Critical evaluation of major theories of learning: Hull, Guthrie, Tolman, Lewin. Application

- of learning theory to major problems in psychology. Prerequisite: Psy. 4 or 407 or 414. *Professor Grosslight*
510. HISTORY OF PSYCHOLOGY (3) Theoretical systems, experiments, and personalities in development of modern psychology until about 1920. Prerequisite: 9 credits in psychology. *Professor Carpenter*
511. CONTEMPORARY AMERICAN PSYCHOLOGY (2-3) Current systems or schools of psychology with comparative study and critical analysis; points of view as presented by recognized leaders. Prerequisite: 9 credits in psychology. *Professor Hall*
513. EDUCATIONAL PSYCHOLOGY: DIFFERENTIAL (2) Causes of differences in achievement and personality; psychological implications of methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*
514. EDUCATIONAL PSYCHOLOGY: LEARNING (2) Experimentally determined facts about the learning process; synthesis of main theories of learning; application of principles related to: motivation, practice, retention, transfer, meaning, and problem solving. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*
515. ADVANCED STATISTICS IN PSYCHOLOGY AND EDUCATION (3) Sampling, tests of significance, factor analysis, analysis of variance and other advanced statistical methods; application of statistical methods to practical problems. Prerequisite: Psy. 415 or Ed. 574. *Professor Kurtz*
517. PSYCHOLOGY OF ATTITUDES AND OPINIONS (3) Acquisition and control of attitudes and opinions, including beliefs, convictions, biases, prejudices, and ideologies as determinants of action. Prerequisite: 18 credits in psychology, including Psy. 417, 422, 437.
518. PROJECTS IN EXPERIMENTAL PSYCHOLOGY (2-4) Individual experimental projects; seminars on experimental design and instrumentation. Prerequisite: Psy. 407.
521. RESEARCH PROBLEMS IN INDUSTRIAL PSYCHOLOGY (2-6) Actual industrial personnel problems in laboratory and industrial plants: monotony, fatigue, psychological selection, and training procedures. Prerequisites: Psy. 21, 431. *Professor Kinsley Smith*
522. ADVANCED PSYCHOLOGICAL MARKETING RESEARCH TECHNIQUES (3) Current literature; special questionnaire designs to test consumer reaction to products, advertising, and company policies from psychological standpoint; scale analysis; consumer motivation. Prerequisite: 15 credits in psychology, including Psy. 15, 21, 422. *Professor Guest*
525. SAMPLING DESIGNS IN MARKET AND OPINION RESEARCH (3) Techniques in selection of samples for accurate representation of human populations; special emphasis on probability sampling. Prerequisites: Psy. 15, 21, 422. *Professor Guest*
526. ANALYSIS AND PRESENTATION OF MARKET AND OPINION RESEARCH DATA (3) Classification and cross-tabulation of data as an aid in understanding research; analysis of opinion data by punch-card equipment. Prerequisites: Psy. 15, 21, 422. *Professor Guest*

PSYCHOLOGY

528. **OPINION RESEARCH ADMINISTRATION** (3-6) Practicum in planning, development of techniques, and administration of the sample survey. Prerequisite: Psy. 428. *Professor Guest*
529. (Ch.Fm. 529). **SEMINAR IN CHILD DEVELOPMENT** (1-6) Readings and reports on recent findings in child development. Prerequisites: Ch. Mm. 429, 430, or Psy. 411 or 425.
534. **APPLICATIONS OF PSYCHOLOGY IN BIO-MECHANICS** (2) Experimental studies of psychological factors affecting design and operation of machines. Prerequisites: Psy. 3 and 4, or 501. *Professor Corso*
539. **MOTIVATION AND EMOTION** (3) Systematic status of instinct, drive, motive, will, purpose; methodology and results of physiological, experimental, and clinical investigation of basic drives. Prerequisites: Psy. 3, 4. *Professor Kendon Smith*
540. **CLINICAL PSYCHOLOGY SEMINAR** (1-6) Seminar on current problems in clinical psychology. Prerequisite: Psy. 482.
541. **DYNAMICS OF HUMAN ADJUSTMENT** (3) Seminar on motivation of human behavior, frustration, and mechanisms of adjustment; normal behavior is stressed. Prerequisite: Psy. 437. *Professor Gorlow*
542. **PSYCHOPATHOLOGY** (3) Covers basic, developmental, human, experimental reactions, showing how normal and pathological character trends and deviations evolve; basic reasons for and applications of psychotherapeutic methods. Prerequisite: Psy. 412 or 437. *Professor Lott*
543. **COUNSELING TECHNIQUES** (2) Survey of psychotherapeutic methods; history, theory, and methods employed; case illustrations. Prerequisite: Psy. 482. *Professor Snyder*
550. **PSYCHOMETRICS: BINET** (2) Measurement of intelligence by Stanford revision of the Binet-Simon technique; demonstrations, lectures; practice administering tests; observations of student by instructor. Prerequisite: Psy. 471. *Professor Ila Gehman*
551. **PSYCHOMETRICS: POINT SCALES** (2) Measurement of intelligence by individual nonverbal techniques: Arthur, Wechsler-Bellevue, and others; demonstrations, lectures, and practice administering tests under observation. Prerequisite: Psy. 471. *Professor Ila Gehman*
552. **PSYCHOMETRICS: PRESCHOOL** (2) Measurement by individual preschool scales: Merrill-Palmer, Minnesota, California First Year; demonstrations, lectures, and practice in administering tests under observation. Prerequisite: Psy. 551.
553. **PSYCHOMETRICS: ADVANCED** (2) Measurement of intelligence, social maturity, and other characteristics; demonstration, lectures, and practice in administering tests; observations by instructor. Prerequisite: Psy. 550. *Professor Bernreuter*
555. **PSYCHOMETRICS: RORSCHACH ADMINISTRATION** (3) Introduction to theory of projective tests; supervised practice in administering and scoring of the Rorschach test. Prerequisite: Psy. 550 or 551. *Professors Guthrie and Gorlow*
556. **PSYCHOMETRICS: RORSCHACH INTERPRETATION** (3) Study of current literature and supervised practice. Prerequisite: Psy. 555. *Professors Guthrie and Gorlow*

557. **PSYCHOMETRICS: ADVANCED PROJECTIVE TECHNIQUES (2-3)** Survey of common projective techniques other than the Rorschach, with supervised practice. Prerequisite: Psy. 556. *Professors Guthrie and Gorlow*
560. **CLINICAL PRACTICUM (2-3)** Applied experience in techniques of clinical psychology; case work in the Psychology Clinic. Prerequisites: Psy. 482, 550, 551.
561. **CLINICAL PRACTICUM: ELEMENTARY SCHOOL (1-3)** Experience in the Psychology Clinic and public schools in learning and adjustment problems; diagnosis and remedial work; pertinent school laws and practices. Prerequisites: Psy. 560 and Ed. 70, or Ed. 432g or 470. *Professor Ila Gehman*
562. **CLINICAL PRACTICUM: VOCATIONAL GUIDANCE (1-3)** Practical experience in the Psychology Clinic on high school, college, and adult vocational guidance cases; staff meetings; seminar on techniques and materials. Prerequisite: Psy. 560 or Ed. 502.
563. **CLINICAL PRACTICUM: MARITAL COUNSELING (1-3)** Experience in the Psychology Clinic on premarital and marital adjustment; seminar on techniques of adjustment and development of sexual and emotional maturity in marriage. Prerequisite: Psy. 560. *Professor Adams*
564. **CLINICAL PRACTICUM: PERSONAL ADJUSTMENT COUNSELING (2-3)** Advanced practicum with experience in counseling of personal adjustment problems referred to the Psychology Clinic. Prerequisite: Psy. 565. *Professor Snyder*
565. **CLINICAL PRACTICUM: NONDIRECTIVE COUNSELING (3)** Practical experience in application of the nondirective method, along with systematic theoretical study of the method. Prerequisites: Psy. 543, 560. *Professor Snyder*
566. **CLINICAL PRACTICUM: HYPNOTHERAPY (1-3)** Practical experience in the Psychology Clinic in use of hypnotherapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.
567. **CLINICAL PRACTICUM: PLAY THERAPY (1-3)** Practical experience in the Psychology Clinic in use of play therapy with young children; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560. *Professor Ila Gehman*
568. **CLINICAL PRACTICUM: GROUP THERAPY (2)** Practical experience in the Psychology Clinic in use of group methods for treatment of personal maladjustments; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565. *Professor Gorlow*
569. **CLINICAL PRACTICUM: ADVANCED NONDIRECTIVE (2)** Practical experience in the Psychology Clinic in advanced nondirective therapy techniques; staff meetings; case conferences. Prerequisite: Psy. 565. *Professor Snyder*
574. **MENTAL DEFICIENCY (3)** Causes of mental deficiency; diagnosis, training, and care of mental defectives. Prerequisite: Psy. 414 or 482.
590. **SEMINAR: ADVANCED (1-2)** Prerequisite: Psy. 500.
591. **SEMINAR ON TEACHING PSYCHOLOGY (1-3)** Objectives and content of psychology; organization and presentation of material; teaching aids and techniques. Prerequisites: Psy. 407 or 501; 510 or 511. *Professor Hall*

PSYCHOLOGY

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 400. HONORS COURSE IN PSYCHOLOGY (2-6) | |
| 401. (P.H. 401). ANIMAL BEHAVIOR (3) | <i>Professor Hale</i> |
| 407. INTERMEDIATE EXPERIMENTAL PSYCHOLOGY (3) | <i>Professor Lepley</i> |
| 411, 411X. PSYCHOLOGY OF THE PRESCHOOL CHILD (3) | <i>Professor van Ormer</i> |
| 412, 412X. ABNORMAL PSYCHOLOGY (3) | <i>Professor DeCamp</i> |
| 414, 414X. INTERMEDIATE EDUCATIONAL PSYCHOLOGY (2-3) | <i>Professor Thevaos</i> |
| 415, 415X. INTERMEDIATE STATISTICS IN PSYCHOLOGY AND EDUCATION (3) | |
| | <i>Professor Kurtz</i> |
| 417. SOCIAL PSYCHOLOGY (2-3) | <i>Professor Carpenter</i> |
| 418. MEASUREMENT OF PERSONALITY (2-3) | <i>Professor Bernreuter</i> |
| 419. GUIDANCE AND EDUCATION IN SEXUAL AND MARITAL ADJUSTMENT (3) | |
| | <i>Professor Adams</i> |
| 420. APPLIED SOCIAL PSYCHOLOGY (3) | <i>Professor Carpenter</i> |
| 422. PSYCHOLOGICAL METHODS OF MEASURING THE REACTIONS OF THE PUBLIC (3) | |
| | <i>Professor Guest</i> |
| 423. TEST CONSTRUCTION AND STANDARDIZATION (2-3) | <i>Professor Kurtz</i> |
| 424, 424X. PSYCHOLOGICAL TECHNIQUES IN PUBLIC PERSONNEL ADMINISTRATION (3) | |
| | <i>Professor Adams</i> |
| 425, 425X. PSYCHOLOGY OF THE ELEMENTARY SCHOOL CHILD (2-3) | |
| | <i>Professor van Ormer</i> |
| 426, 426X. ADOLESCENCE (2-3) | <i>Professor Thevaos</i> |
| 427. PSYCHOLOGICAL PRINCIPLES IN ADVERTISING (3) | <i>Professor Guest</i> |
| 428. OPINION RESEARCH LABORATORY (3) | <i>Professor Guest</i> |
| 429. PSYCHOLOGY OF COMMUNICATION (3) | |
| 431, 431X. INDUSTRIAL PSYCHOLOGY (3) | <i>Professor Kinsley Smith</i> |
| 437, 437X. PSYCHOLOGY OF ADJUSTMENT (3) | <i>Professor Gorlow</i> |
| 438. THEORY OF PERSONALITY (3) | <i>Professor Grosslight</i> |
| 440. PSYCHOLOGY PROJECTS (1-6) | |
| 445. (Ch.Fm. 445). DEVELOPMENT THROUGHOUT ADULTHOOD (3) | |
| 471, 471X. MEASUREMENT OF INTELLIGENCE (2) | <i>Professor Bernreuter</i> |
| 472. SPECIAL ABILITY TESTING (3) | |
| 482. INTRODUCTION TO CLINICAL PSYCHOLOGY (3) | <i>Professor Snyder</i> |

PUBLIC UTILITIES

PROFESSOR ARTHUR H. WAYNICK, B.S., M.S., Sc.D.
Head of the Department of Electrical Engineering

521. PUBLIC UTILITIES (3) Problems of current interest in the public utility field, principally those utilities involving use of principles of electrical engineering.
Professor Powell

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

421. ELECTRIC UTILITIES (3) *Professor Powell*

RECREATION

Consult PROFESSOR FRED M. COOMBS, M.A.

530. CAMP ADMINISTRATION (3) Camp site development; staff selection, training, and supervision; development of objectives and program planning; values inherent in outdoor and camping education. Prerequisite: Recr. 430.
Professor Coombs
533. RECREATION STUDIES, SURVEYS, AND APPRAISALS (3) Types, purposes, and methods of conducting recreation studies and surveys; procedures in appraisal of community recreation. Prerequisite: Ph.Ed. 530.
Professor Coombs
560. ADMINISTRATIVE PROBLEMS OF RECREATION (3) Administrative problems in park and recreation departments; departmental organization, finance, personnel, facilities, program, and public relations. Prerequisite: Recr. 465.
Professor Coombs

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

430. CAMP COUNSELING (3) *Professor Coombs*
 432. RECREATION IN INDUSTRY (3) *Professor Coombs*
 434. RECREATION AREAS AND FACILITIES (3) *Professor Coombs*
 456, 456X. SOCIAL RECREATION (3) *Professor White*
 461, 461X. PROGRAMS OF COMMUNITY RECREATION (1 per unit) *Professor Coombs*
 Unit A. Programs of the Rural Community (1)
 Unit B. Programs of the Urban Community (1)
 Unit C. Programs of Large Municipalities (1)
 462. RECREATION FOR THE HANDICAPPED (3) *Professor White*
 465, 465X. ADMINISTRATION OF RECREATION (3) *Professor Coombs*

*RURAL SOCIOLOGY

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.

Head of the Department of Agricultural Economics and Rural Sociology

551. RURAL SOCIOLOGY SEMINAR (1-6) Prerequisite: 6 credits in rural sociology, sociology, or psychology.
552. ADVANCED RURAL SOCIOLOGY (3) Structure and functioning of rural society.
Professor John
553. SEMINAR IN RURAL SOCIOLOGICAL RESEARCH (1-6) Continuation of R.Soc. 552. Functioning of rural society; research dealing with the subject reviewed and evaluated.

* Credit in rural sociology will also be given for Agr.Ec. 505 and 525.

RURAL SOCIOLOGY

554. ADVANCED RURAL SOCIAL WELFARE (3) Analysis of welfare techniques and their application to rural situations. Prerequisites: R.Soc. 11; Psy. 2 or R.Soc. 459. *Professor Mather*
555. THE RURAL CHURCH (3) The rural church as a social institution; its relation to the community; the church in "problem" areas; effects of population trends on the program of the rural church; use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology. *Professor Mather*
557. THE DEVELOPMENT OF THE RURAL COMMUNITY (3) Origin and evolution of the rural community under different geographic and cultural conditions. Prerequisites: R.Soc. 11 or Soc. 1; R.Soc. 452. *Professor Mather*
559. ADVANCED RURAL SOCIAL PSYCHOLOGY (3) Application of social psychological principles to treatment of rural problems. Prerequisites: R.Soc. 11, Psy. 2. *Professor Green*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

452. RURAL ORGANIZATION (3) *Professor Brown*
454. RURAL SOCIAL WELFARE (3) *Professor Mather*
456. RURAL STANDARDS OF LIVING (3) *Professor Mather*
459. RURAL SOCIAL PSYCHOLOGY (3) *Professor Green*

RUSSIAN

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.
Head of the Department of Romance Languages

The following courses may be taken for graduate credit under the restrictions in force:

401. STUDIES IN RUSSIAN LITERATURE (3-6)
425. PUSHKIN (3)

SOCIOLOGY

PROFESSOR ROBERT E. CLARK, M.A., Ph.D.
Acting Head of the Department

503. SEMINAR IN SOCIAL PSYCHOLOGY (3-9) Investigation of theories, methods, and empirical data of social psychology, with particular reference to such problems as relations between personality and culture, social and personal disorganization, development of role behavior, and conception of the self. *Professor Coutu*
510. FIELD WORK IN SOCIOLOGY (1-6)
513. SEMINAR IN SOCIOLOGICAL RESEARCH PROBLEMS: A. RESEARCH TECHNIQUES; B. CURRENT RESEARCH (3-6) Prerequisites: Soc. 413; 3 credits in statistics. *Professors John and Bernard*

515. SEMINAR IN COMMUNITY STUDIES (3) *Professor Bernard*
516. SEMINAR IN SOCIOLOGICAL THEORY (3-9) *Professors Green and Blizzard*
523. POPULATION PROBLEMS (1-9) *Professor Clark*
525. SEMINAR IN SOCIOLOGY (1-9) Research problems in theoretical and applied sociology.
530. RESEARCH ON MARRIAGE AND THE FAMILY (3) Training in methods and techniques of research in family relations. Under the guidance of the instructor, experimental, statistical, and comparative studies are carried out, individually or co-operatively. Prerequisite: 3 credits of previous work in this field. *Professor Bernard*
572. METHODS OF SAMPLING (3) Application of sampling techniques to sociological research. Prerequisite: Soc. 471. *Professor Clark*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. SOCIAL INSTITUTIONS (3) *Professor Green*
- 403a-403b. ADVANCED SOCIAL PSYCHOLOGY (3 each) *Professor Coutu*
- 405S. SOCIAL PROBLEMS (3)
413. METHODS AND TECHNIQUES OF SOCIAL RESEARCH (1-6) *Professor Bernard*
418. THE DEVELOPMENT OF SOCIAL THOUGHT (3)
423. POPULATION RESEARCH (3) *Professor Clark*
424. SOCIAL CHANGE (3) *Professor Abramson*
425. CONTEMPORARY SOCIOLOGICAL THEORY (3) *Professor Green*
426. INTRODUCTION TO PUBLIC WELFARE (3) *Professor Mather*
- 427S. FAMILY CASE WORK (6)
429. SOCIAL STRATIFICATION (3)
431. COMMUNICATION AND MASS SOCIETY (3) *Professor Abramson*
470. USE OF STATISTICS IN SOCIOLOGY (3) *Professor Clark*
- 495S. (Ch.Fm. 495S, Ed. 495S, Hl.Ed. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3)
- 499X. FOREIGN STUDY IN SOCIOLOGY (2-6)

SPANISH

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.
Head of the Department of Romance Languages

- *1G. ELEMENTARY SPANISH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.
544. NEOCLASSICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Neoclassic movement in Italy, France, Spain, and Portugal.

* No graduate credit is given for this course.

SPANISH

545. ROMANTICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Romantic movement in Italy, France, Spain, and Portugal.
546. MEDIEVAL ROMANCE LITERATURES (3) Nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal.
547. REALISM, WITH PARTICULAR REFERENCE TO ROMANCE LITERATURE (3)
548. 20TH CENTURY ROMANCE LITERATURE AS A POLITICAL FORCE (3)
551. ROMANCE PHILOLOGY (3) Historical development of the Romance languages.
552. OLD SPANISH READINGS (3) Familiarizes the student with Old Spanish texts.
- 561-562. SPANISH DRAMA PREVIOUS TO LOPE DE VEGA (3 each) Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed.
565. LOPE DE VEGA (3)
566. LOPE DE VEGA'S FOLLOWERS (3)
- 567-568. CERVANTES AND HIS WORKS (3 each)
571. SEMINAR IN SPANISH LITERATURE (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.
572. SEMINAR IN SPANISH LITERATURE (3) Continuation of Sp. 571.
574. METHODS AND BIBLIOGRAPHY IN ROMANCE LANGUAGES AND LITERATURES (1-2)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. THE GOLDEN AGE (3)
402. DRAMA OF THE GOLDEN AGE (3)
403. DON QUIXOTE (3)
404. OLD SPANISH LANGUAGE AND LITERATURE (3)
405. SPANISH DRAMA OF THE 19TH CENTURY (3)
406. CONTEMPORARY SPANISH DRAMA (3)
407. THE SPANISH NOVEL OF THE 19TH CENTURY (3)
408. THE CONTEMPORARY SPANISH NOVEL (3)
- 409, 409X. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)
410. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)
411. MEXICO: ITS LANGUAGE AND LITERATURE (3)
412. ARGENTINA: ITS LANGUAGE AND LITERATURE (3)
415. MODERN SPANISH LYRIC POETRY (3)
417. SPANISH LITERATURE IN THE ROMANTIC PERIOD (3)
421. THE TEACHING OF ROMANCE LANGUAGES (3)
471. PROBLEMS IN SPANISH LITERATURE (3-6)
490. ADVANCED COMPOSITION AND CONVERSATION (3)
496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

SPEECH

PROFESSOR ROBERT T. OLIVER, M.A., Ph.D., LL.D.

Head of the Department

500. SEMINAR IN AMERICAN ORATORY (2-4) History of American oratory, with application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Spch. 200. *Professor Joseph O'Brien*
505. HISTORICAL DEVELOPMENT OF SPEECH THEORY (2-4) Survey of ancient, medieval, and modern theories of public address in relation to currently accepted speech theories. *Professor DeBoer*
508. SEMINAR IN BRITISH ORATORY (2-4) History of British oratory; application of critical standards to the work of selected orators. *Professor Fife*
510. SEMINAR IN METHODS OF TEACHING SPEECH (2-4) Curriculum construction, media, and methods in high school and college. Prerequisite: 6 credits in speech including Spch. 200. *Professor Joseph O'Brien*
520. SEMINAR IN SPEECH SCIENCE (2-4) Seminar in physical and physiological bases of speech and voice; introduction to laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology. *Professor Brubaker*
540. SEMINAR IN THE PROBLEMS OF RADIO (3) Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 credits in speech including Spch. 200, 300; 425 or 435. *Professor Nelson*
550. SEMINAR IN ORAL PERSUASION (2-4) Theory and devices of persuasion; analysis of persuasive discourse. Prerequisite: 6 credits in speech including Spch. 200. *Professor Oliver*
555. SPEECH COMMUNICATION: PROBLEMS AND PRINCIPLES (2-4) Prevalent theories of speech influence. *Professor Oliver*
560. PUBLIC ADDRESS (2-4) Discussion and criticism of speech outline, manuscript, content, composition, and delivery. Prerequisite: 6 credits in speech including Spch. 200. *Professor Schug*
575. RESEARCH PROBLEMS IN SPEECH (1-12) Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. TEACHING OF SPEECH (3) *Professor Schug*
401. PROBLEMS, METHODS, AND AREAS IN SPEECH (1) *Professor Carter*
402. INTRODUCTION TO GENERAL SEMANTICS (3) *Professor Carter*
- 405a,b,cS. PRACTICAL PROBLEMS IN PUBLIC AND PRIVATE SPEECH (1-3)
410. ENGLISH PHONETICS AND PRONUNCIATION (3) *Professor Brubaker*
- 411a,b,cS. SPEECH SCIENCE AND SPEECH ARTS (1-3)

SPEECH

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| 412. SPEECH COMPOSITION (3) | Professor DeBoer |
| 415. EXPERIMENTAL AND APPLIED PHONETICS (3) | |
| 416. METHODS OF COACHING DEBATE (3) | Professor Harold O'Brien |
| 425. ADVANCED PRINCIPLES OF RADIO SPEECH (3) | Professor Mackey |
| 431. ANATOMY AND PHYSIOLOGY OF THE EAR AND VOCAL MECHANISMS (3) | Professor Brubaker |
| 435. RADIO ORGANIZATION (3) | Professor Nelson |
| 437. PRINCIPLES OF TELEVISION SPEECH (3) | Professor Nelson |
| 445. SPEECH AS A MEDIUM OF INTERNATIONAL RELATIONS (3) | Professor Oliver |
| 450. DISCUSSION TECHNIQUES (3) | Professor Joseph O'Brien |

SPEECH EDUCATION

Consult PROFESSOR EUGENE T. McDONALD, M.Ed., D.Ed.

525. SEMINAR IN CLINICAL SPEECH PATHOLOGY (2-6) Prerequisites: Sph.Ed. 436, 442.
Unit A. Cleft Palate
Unit B. Cerebral Palsy
Unit C. Aphasia
530. SEMINAR IN AUDIOLOGY (2-4) Review of theories of hearing, and review of related physiological and psychological researches. Prerequisite: Sph.Ed. 434.
537. ADVANCED CLINICAL PRACTICE IN SPEECH CORRECTION (1-9) Prerequisites: Sph.Ed. 437, 442.
Unit A. Diagnostic Procedures (1-3)
Unit B. Treatment Procedures (1-6)
540. ARTICULATION DISABILITIES (3) Speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisites: Sph.Ed. 437, 442.
541. THE VOICE AND ITS DISORDERS (3) Physical, physiological, and psychological bases of voice production; causes, nature, and symptoms of its disorders; current clinical methods in voice improvement. Prerequisites: Sph.Ed. 437, 442.
542. STUTTERING AND ALLIED DISORDERS (3) Modern theories of causes of disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisites: Sph.Ed. 437, 442.
543. DIAGNOSTIC PROCEDURES IN CLINICAL SPEECH (3) Clinical instrumentation; case history taking; examination procedures and materials used in diagnosing speech disabilities; interpretation of findings; report preparation. Prerequisites: Sph.Ed. 437, 442.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

430. HEARING PROBLEMS AND THE TESTING OF HEARING (3)
 434. AUDIOMETRY AND HEARING AIDS (3)
 435. CLINICAL PRACTICE WITH THE HEARING HANDICAPPED (1-6) Units A, B.
 436. INTRODUCTION TO SPEECH CORRECTION (3)

437. CLINICAL PRACTICE IN SPEECH CORRECTION (1-3)
 439X. FUNDAMENTALS OF SPEECH EDUCATION (3)
 439aX. METHODS IN SPEECH EDUCATION (3)
 440, 440X. SPEECH EDUCATION FOR THE CLASSROOM TEACHER (2-3)
 441S. CURRENT PROBLEMS IN SPEECH AND HEARING (1-6)
 442. SPEECH PATHOLOGY (3)
 443. METHODS IN AUDITORY TRAINING AND SPEECH READING (3)
 445. THE PUBLIC SCHOOL SPEECH CORRECTION PROGRAM (3)

ZOOLOGY

PROFESSOR BERTIL G. ANDERSON, M.S., Ph.D.

Head of the Department of Zoology and Entomology

508. ADVANCED PARASITOLOGY (3) Advanced work on the structure, life cycle, and control of parasites. Prerequisites: Ent. 2, Zool. 432. *Professor Zelif*
509. TECHNIQUES IN WILDLIFE MANAGEMENT (3) Preparing study mounts, census making, management area mapping, methods of collecting data, and determining food habits from stomach contents. Prerequisite: Zool. 546. *Professor English*
512. SEMINAR (1) Review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology. *Professor English*
513. RESEARCH (1-15 per semester) Prosecution of an assigned problem under the guidance of an instructor. Prerequisite: Zool. 410, 432, 437, 440, or 546.
514. SPECIAL TOPICS IN ZOOLOGY (3) Individual problems in any field of zoology, with or without experimental work. Prerequisite: Zool. 26.
- 532S. ANIMAL PARASITES (3) Structure, life cycle, and control. Prerequisite: Zool. 432.
541. COMPARATIVE PHYSIOLOGY (3) Dynamics of vital processes as shown in members of the animal kingdom. Prerequisites: Zool. 26, A.B.Ch. 1, A.B.Ch. 425 or Zool. 437. *Professor Frings*
546. THE THEORY OF GAME MANAGEMENT (4) Fundamental principles underlying management of wild game birds and mammals; co-ordination of such management with various land uses; planning preserves and other land areas. Prerequisites: Zool. 408, 420. *Professor English*
- 547S. WILDLIFE MANAGEMENT (3) Basic principles concerned with management of game birds and game mammals. Prerequisite: Zool. 420. *Professor English*
551. FISHERIES MANAGEMENT (3) Basic principles underlying management of inland waters for fish production. Prerequisite: Zool. 450.
581. ADVANCED INVERTEBRATE ZOOLOGY (3) Morphology, physiology, taxonomy, and life histories of invertebrate animals. *Professor Frings*

ZOOLOGY

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

408. MAMMALOGY (4)	<i>Professor English</i>
410. GENERAL LIMNOLOGY (3)	
415. THE LITERATURE OF ZOOLOGY (1)	<i>Professor Frings</i>
416. THE METHODS OF RESEARCH IN ZOOLOGY (2)	
417. INVERTEBRATE FAUNISTICS (4)	<i>Professor Frings</i>
418S. FIELD ORNITHOLOGY (3)	<i>Professor Wood</i>
419S. GENERAL ANIMAL ECOLOGY (3)	<i>Professor Blackburn</i>
420. GAME BIRDS (3)	<i>Professor English</i>
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436. PROTOZOOLOGY (3)	<i>Professor Zelif</i>
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440. EMBRYOLOGY (4)	<i>Professor Newman</i>
444. ZOOLOGICAL PROBLEMS (1-6)	
448. ORNITHOLOGY (3)	
450. ICHTHYOLOGY (4)	<i>Professor Wood</i>

1855
PENN STATE
CENTENNIAL
1955

THE PENNSYLVANIA STATE UNIVERSITY BULLETIN

Graduate School Announcement
1955-56



1855 ~ 1955
A CENTURY
OF EDUCATIONAL SERVICE

THE PENNSYLVANIA STATE UNIVERSITY

One Hundred Years of Growth

	<i>A Century Ago</i>	<i>Today</i>
Enrollment	119	14,000
Resident Instruction Faculty	4	1,400
Courses	40	<i>More Than</i> 3,000
Curriculums	1	59
Buildings	1	140
Valuation of Plant	\$50,000	\$68,000,000
Degrees Granted	11	<i>More Than</i> 2,600

In 1954-55, the University ranked 9th in the Nation in full-time resident enrollment.

Degrees granted since the founding of the University total 56,000.

Although graduate work had been given as early as 1862, the Graduate School was not formally established until 1922. Since then it has granted a total of 8782 advanced degrees.

THE PENNSYLVANIA STATE UNIVERSITY BULLETIN

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STATE COLLEGE, PENNSYLVANIA

THE PENNSYLVANIA STATE
UNIVERSITY BULLETIN

Graduate School
Announcement

1955-1956

1855 A CENTURY 1955
OF EDUCATIONAL SERVICE

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THE GRADUATE SCHOOL CALENDAR

SPRING SEMESTER 1955

FEBRUARY 1955

- 2-5 Wednesday to Saturday—Spring Semester Registration
- 7 Monday—Spring Semester Classes Begin 8 a.m.
- 17 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 19 Saturday Noon—Last Date for Students to Add Courses

MARCH

- 5 Saturday Noon—Last Date for Students to Drop Courses
- 7 Monday—Foreign Language Examinations for Doctorates
- 17 Thursday—Graduate Faculty Meeting 4:10 p.m.

APRIL

- 6 Wednesday—Spring Recess Begins 11:50 a.m.
- 13 Wednesday—Spring Recess Ends 1:10 p.m.
- 14 Thursday—Graduate Faculty Meeting 4:10 p.m.

MAY

- 12 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 21 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 23 Saturday—Spring Semester Classes End 11:50 a.m.
- 28 Saturday—Spring Semester Examinations Begin 1:20 p.m.
- 30 Monday—Memorial Day Recess

JUNE

- 8 Wednesday—Spring Semester Ends 12:30 p.m.
- 10 Friday—Baccalaureate Day
- 11 Saturday—Commencement Day

SUMMER SESSIONS 1955

JUNE 1955

- 13 Monday—Registration for Inter-Session 8 a.m. to 12 noon
- 13 Monday—Inter-Session Classes Begin 1:20 p.m.

JULY

- 1 Friday—Inter-Session Ends 5:50 p.m.
- 4 Monday—Independence Day Recess
- 5 Tuesday—Registration for Main Summer Session
- 6 Wednesday—Main Summer Session Classes Begin 8 a.m.
- 23 Saturday—Cap and Gown Fee Due 5:30 p.m.

AUGUST

- 12 Friday—Main Summer Session Ends 5:50 p.m.
- 13 Saturday—Main Summer Session Graduation Exercises
- 15 Monday—Registration for Post-Session 8 a.m. to 12 noon
- 15 Monday—Post-Session Classes Begin 1:20 p.m.

SEPTEMBER

- 2 Friday—Post-Session Ends 5:50 p.m.

FALL SEMESTER 1955

SEPTEMBER 1955

- 14-17 Wednesday to Saturday—Fall Semester Registration
- 19 Monday—Fall Semester Classes Begin 8 a.m.
- 30 Friday—Convocation of The Graduate School 7:30 p.m.

OCTOBER

- 1 Saturday Noon—Last Date for Students to Add Courses
- 15 Saturday Noon—Last Date for Students to Drop Courses
- 20 Thursday—Graduate Faculty Meeting 4:10 p.m.

NOVEMBER

- 7 Monday—Foreign Language Examinations for Doctorates
- 17 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 23 Wednesday—Thanksgiving Recess Begins 11:50 a.m.
- 28 Monday—Thanksgiving Recess Ends 8 a.m.

DECEMBER

- 15 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 21 Wednesday—Christmas Recess Begins 11:50 a.m.

JANUARY 1956

- 4 Wednesday—Christmas Recess Ends 1:10 p.m.
- 7 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 12 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 18 Wednesday—Fall Semester Classes End 5 p.m.
- 19 Thursday—Fall Semester Examinations Begin 8 a.m.
- 27 Friday—Fall Semester Ends 5:30 p.m.
- 30 Monday—Fall Semester Graduation Exercises

SPRING SEMESTER 1956

FEBRUARY 1956

- 1-4 Wednesday to Saturday—Spring Semester Registration
- 6 Monday—Spring Semester Classes Begin 8 a.m.
- 16 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 18 Saturday Noon—Last Date for Students to Add Courses

MARCH

- 3 Saturday Noon—Last Date for Students to Drop Courses
- 5 Monday—Foreign Language Examinations for Doctorates
- 22 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 28 Wednesday—Spring Recess Begins 11:50 a.m.

APRIL

- 4 Wednesday—Spring Recess Ends 1:10 p.m.
- 26 Thursday—Graduate Faculty Meeting 4:10 p.m.

MAY

- 19 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 24 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 26 Saturday—Spring Semester Classes End 11:50 a.m.
- 26 Saturday—Spring Semester Examinations Begin 1:20 p.m.
- 30 Wednesday—Memorial Day Recess

JUNE

- 6 Wednesday—Spring Semester Ends 12:30 p.m.
- 8 Friday—Baccalaureate Day
- 9 Saturday—Commencement Day

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 FREDERICK L. GWYNN, A.M., Ph.D. *Associate Professor of English Literature*
 BEATRICE LIBERTY HAGEN, M.A., Ph.D. *Associate Professor of Mathematics*
 JOHN F. HALL, M.A., Ph.D. *Associate Professor of Psychology*
 DONALD EDWARD HARDENBERGH, M.S. *Associate Professor of Engineering Mechanics*
 WALTER JOEL HARRINGTON, M.A., Ph.D. *Associate Professor of Mathematics*
 JOHN ROBERT HAYES, M.S., Ph.D. *Associate Professor of Chemistry*
 CARROLL E. HEIST, M.S., Ph.D. *Associate Professor of Bacteriology*
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 RODNEY E. HERSH, M.S. *Associate Research Professor of Chemical Engineering*
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 CHARLES L. HOSLER, JR., M.S., Ph.D. *Associate Professor of Meteorology*
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 NEIL A. McNALL, M.A., Ph.D. *Associate Professor of American History*

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 JOHN R. MENTZER, M.S., Ph.D. *Associate Professor of Electrical Engineering*
 WARREN W. MILLER, Ph.D. *Associate Professor of Chemistry*
 WILFORD RICHARD MILLS, Ph.D. *Associate Professor of Plant Pathology*
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 VERNON W. MYERS, M.A., Ph.D. *Associate Professor of Physics*
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MERRILL WOOD, M.S.

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JAMES EVERETTE WRIGHT, Ph.D.

Associate Professor of Genetics

KELLY YEATON, M.A.

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ADAM ANTHONY, M.S., Ph.D.

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	Assistant Professor of Romance Languages
MICHAEL CHIAPPETTA, M.A., Ph.D.	Assistant Professor of Education
WILLIAM E. COBB, M.Ed., D.Ed.	Assistant Professor of Education
JOSEPH J. COMER, M.S.	Assistant Professor of Mineral Sciences
RALPH W. CONDEE, A.M., Ph.D.	Assistant Professor of English Literature
CLYDE G. CORLE, M.A., D.Ed.	Assistant Professor of Education
WILLIAM CRAIG, Ph.D.	Assistant Professor of Mathematics
HOLLE G. DEBOER, M.A.	Assistant Professor of Public Speaking
NORMAN C. DENO, M.S., Ph.D.	Assistant Professor of Chemistry
FELIX DU BREUIL, M.S., Ph.D.	Assistant Professor of Mining Engineering
CHARLES E. DUKE, M.S., Ph.D., P.E.	
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DAVID C. EKEY, M.Sc., P.E.	Assistant Professor of Industrial Engineering
ILINE FIFE, M.A., Ph.D.	Assistant Professor of Speech
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JOHN ALLEN FITZ, M.A.	Assistant Professor of Elementary Education
EDWIN R. FITZGERALD, M.S., Ph.D.	Assistant Professor of Physics
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PHYLLIS RICE GRIESS, M.A., Ph.D.	Assistant Professor of Geography
PAUL GRUN, Ph.D.	Assistant Professor of Genetics
CHARLES GUSTAVUS HAAS, JR., S.M., Ph.D.	Assistant Professor of Chemistry
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MARY E. HAWTHORNE, M.S., Ph.D.	Assistant Professor of Botany
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HARRY K. HUTTON, M.A., D.Ed.	Assistant Professor of Secondary Education
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EDWARD ALLEN MASON, Ph.D.	Assistant Professor of Chemistry
EDWARD L. MATTIL, M.A., D.Ed.	Assistant Professor of Art Education
GERALD M. MOSER, D.U.P.	Assistant Professor of Romance Languages
WERNER J. MUELLER, Dr.Sc.Tech.	Assistant Professor of Poultry Husbandry
ROBERT KEITH MURRAY, M.A., Ph.D.	Assistant Professor of History
WILLIAM T. NEARN, M.F., D.For.	Assistant Professor of Wood Utilization
RICHARD P. NICKELSEN, M.S., Ph.D.	Assistant Professor of Geology

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Assistant Professor of Soil Technology

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THOMAS R. PORTER, M.A., Ph.D.

Assistant Professor of Nature Education

LEON JAY QUINTO, M.A., Ph.D.

Assistant Professor of Economics

MARGARET C. RAABE, M.S.

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ROBERT LEWIS RIDDLE, M.S.

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GUY RINDONE, M.S., Ph.D.

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C. MARSHALL RITTER, M.S., Ph.D.

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THOMAS WARTIK, Ph.D.

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HAROLD D. WRIGHT, M.A., Ph.D.

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C. COURSON ZELIFF, M.S., Ph.D.

Assistant Professor of Zoology

LEONARD N. ZIMMERMAN, M.S., Ph.D.

Assistant Professor of Bacteriology

HARRY DAVID ZOOK, M.S., Ph.D.

Assistant Professor of Chemistry

OTHER MEMBERS OF THE GRADUATE FACULTY

CHRISTINE W. AYOUB, A.M., Ph.D.

Lecturer in Mathematics

LESLIE P. GREENHILL

Associate Director of the Instructional Film Research Program

GEORGE R. HUDSON, M.A., Ed.D.

Lecturer in Education

CHARLES J. MCINTYRE, M.S., Ph.D.

Co-ordinator of Research, Instructional Film Research Program

AMOS EARL NEYHART, M.S.

Administrative Head of the Institute of Public Safety

EDWARD C. THADEN, D.U.P.

Instructor in History

ROBERT M. WITUCKI, M.S., Ph.D.

Research Associate in Ceramics

THE GRADUATE SCHOOL

GRADUATE WORK at The Pennsylvania State University was first offered in 1862 when two graduate students were in residence. It was given more formal recognition in 1864 by the establishment of a "Course for Graduates" designed for students who, after receiving the degree of Bachelor of Scientific Agriculture, wished to do advanced work leading to the degree of Master of Scientific Agriculture. For some time there were few graduate students, and graduate instruction was relatively unorganized. Later a committee of the University Senate was given the responsibility of establishing standards and regulations governing graduate work and the granting of advanced degrees. The Graduate School was organized in 1922. Until this time only master's degrees and certain technical degrees had been conferred. In 1924, upon recommendation of the Graduate School, the Board of Trustees authorized the granting of the degree of Doctor of Philosophy. Still later other degrees were approved.

The faculty of the Graduate School consists of the President and certain other general administrative officers of the University, the Deans, the University Examiner, the Librarian, the heads of departments, and those members of the instructional staff who have been authorized by the proper agencies of the Graduate School to offer graduate courses and supervise research leading to theses. It controls all academic matters pertaining to the Graduate School, subject to review by the University Senate.

The graduate faculty numbers approximately 580 members. Graduate student enrollment in 1953-54 was about 1400 per semester. During the summer sessions the graduate enrollment increased to approximately 2000. The number of advanced degrees conferred in 1953-54 was 708, of which 113 were doctor's degrees.

An applicant for admission to the Graduate School should understand that graduate work is not an extension of undergraduate work. It operates at a definitely higher level, demands scholarship of a high order, and emphasizes research and creativity. It involves a minimum of formal requirements and regulations, and a maximum of student initiative and responsibility.

A student is expected to assume full responsibility for knowing the regulations and pertinent procedures of the Graduate School (as set forth in the *Graduate School Announcement* and in the *Manual for Graduate Students*) and for meeting the standards and requirements expressed by these regulations. The *Manual*, which is available to a student after he has been admitted, sets forth in more detail the general regulations outlined in the *Announcement* and furnishes other information about the Graduate School which is useful to graduate students. Every student should secure a copy of this manual from the Dean's Office as soon after admission as possible.

PROCEDURES AND REGULATIONS

ADMISSION—A student does not become a graduate student merely by enrolling for advanced courses after having received a baccalaureate degree. Formal admission to the Graduate School is required. Credits earned before admission cannot be applied to meet degree requirements at a later date even though admission may have been granted in the meantime.

ADMISSION

For admission to the Graduate School an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit conditions substantially equivalent to those required by The Pennsylvania State University. He must have maintained during his junior and senior years a minimum grade point average equivalent to 1.5 on The Pennsylvania State University grading scale. Finally, he must ordinarily have completed in a satisfactory manner a certain minimum of course work in designated areas, the specific courses and amount of required work depending upon the field of advanced study which the student proposes to enter.

The minimum average of 1.5 during the last two undergraduate years is a general requirement of the Graduate School. Individual departments may require a higher average for admission to advanced study in their fields. Prospective students are encouraged to write directly to the head of any department concerning graduate work in that specific field.

Foreign students are encouraged to write to the Director of Foreign Student Affairs for information concerning financial matters, housing, and other non-academic problems.

An applicant for admission who has done considerable high quality graduate work in a graduate school known to maintain high standards will be considered on the basis of his entire record.

Admission to the Graduate School is granted by the Dean of Admissions after approval of the application for admission by the department in which the student plans to do his major work. Blanks to be used in making formal application for admission can be obtained from the Dean of Admissions. With his application each student should present the names of two persons to whom departments may write, and who are well qualified to evaluate his abilities for graduate work in the field of his choice.

An applicant for admission should provide complete credentials, in duplicate, sent directly from other institutions to the Dean of Admissions well in advance of the date when the student expects to enroll. If the applicant has attended more than one institution, two official transcripts of the work covered at each institution are required. This applies to the complete academic record, both undergraduate and graduate.

If credentials are not sent in advance or are not available at the time of registration, this does not necessarily mean that the application for admission will be refused. However, it does mean that the applicant will be admitted only on a provisional basis pending receipt of his official credentials. The provisional admission will be subject to cancellation if the credentials, on their arrival, do not meet all the requirements for admission to the Graduate School. Also, certification of any scheduled credits while the applicant is holding provisional admission will be withheld until receipt of his official credentials makes possible his permanent admission to the Graduate School. If the provisional admission should, for any reason, be canceled, the student is thereby automatically dropped from the Graduate School and as a consequence will be required to cease attending any 500 level courses for which he may have registered. He may continue to attend 400 level courses provided he applies for and is accepted for registration as a special student.

Formal readmission is not required year by year nor after one or more semesters of absence from the campus unless the student has completed more than 12 credits of work at another institution in the meantime. In this case

readmission is required, and evidence of good standing at the institution involved is essential. A student who has earned a master's degree at The Pennsylvania State University should not register for further degree work until his academic record and personal qualifications have been reviewed critically by the department of his major interest and a candidacy evaluation has been completed.

The President of the University, on recommendation of the Dean of the Graduate School, will welcome doctors of philosophy of The Pennsylvania State University, as well as those of other accredited colleges and universities, as guests of the University, with the privilege of attending seminars and courses and of carrying on research in laboratories and libraries. There will be no charge except for laboratory expenses. Arrangements should be made in advance with the Dean of the Graduate School.

CLASSIFICATION—At the time of admission a student is classified either as a regular graduate student or as a general graduate student. Regardless of classification, all students, upon admission to the Graduate School, must register through the Graduate Dean's office for all work taken, whether or not that work is to be credited toward the requirements for a degree.

Regular Graduate Students—This group includes those persons who plan to become candidates for degrees at The Pennsylvania State University and who have been formally admitted by the Dean of Admissions for advanced study in a particular department. The program of study is developed under the guidance of the department head or his representative. A graduate student who plans to be a candidate for an advanced degree should enroll as a regular graduate student.

It should be emphasized that a student is not a regular graduate student unless he has been officially admitted to that status. Regular attendance in the Graduate School or personal plans for future degree candidacy do not in themselves grant the status or privileges of a regular graduate student.

A regular graduate student who has passed a candidacy evaluation is classified as a doctoral candidate and may register for doctoral thesis credit.

General Graduate Students—An applicant who meets all requirements for admission to the Graduate School, but who does not wish to work for an advanced degree at this institution, may arrange for a program of work as a general graduate student. This classification includes those who plan to transfer credits to another institution and those who plan to follow a special program of study for the fulfillment of requirements other than those for advanced degrees. The program of study is developed under the guidance of an adviser appointed by the Dean of the Graduate School.

The status and standing of a general graduate student will be reviewed by the Dean each time he reregisters. He may not remain a general graduate student longer than one semester (or summer sessions totaling 12 weeks) except with the permission of the Dean, and for definite and good reasons.

When a general graduate student wishes to become a regular graduate student, i.e., to work for an advanced degree at this institution, he should make application for change of status. His undergraduate record will then be re-evaluated to determine to what extent he is prepared to undertake graduate work for a degree in the major field of his choice. He should understand that he may thereafter apply toward degree requirements only those credits earned

REGISTRATION

as a general graduate student which fit logically into an integrated degree program. There is no upper limit on the number of credits that may be so applied; neither is there any assurance that any such credits may be applicable.

Special and Unclassified Students—A special or an unclassified student is not a graduate student, inasmuch as he has not been admitted to the Graduate School. Consequently he is not permitted to register for graduate courses (500 series). A special or an unclassified student who is later admitted to the Graduate School may not then count toward degree requirements any credits whatsoever that he has earned while in the special student status.

REGISTRATION—A student is required to register for each semester and each summer session in which he proposes to do either course work or research, either on or off the campus.

For each registration the student, in consultation with his adviser, prepares a schedule of courses and research designed to fit his individual needs, which is then submitted to the Dean of the Graduate School for his approval. The registration process is then completed in the manner specified for all students at the University.

Under certain conditions credit may be earned by work done off the campus. A student contemplating such work should inquire of the Dean of the Graduate School about the procedures and conditions. Such work must be scheduled *in advance* in the regular manner.

Registration dates are given in the University Calendar and a penalty fee is assessed for failure to register on the appointed days. In any case, registration must be completed within the first two weeks of a semester or within the first one-sixth of any summer session. All changes of schedule must also be completed within this period, with the exception that a student may drop a course at any time within the first four weeks of a semester. A student who is granted permission to register after the beginning of classes will, in general, be required to take a reduced load.

ACADEMIC LOAD—A full-time student is one who devotes "all" his time to studies and/or research, and very little, if any, time to work for financial compensation. The normal maximum full-time credit load is 15 credits per semester, or 1 credit per week in shorter terms such as summer sessions. Larger loads may be scheduled very rarely and only with the approval of the Dean of the Graduate School. Ordinarily a student employed for more than a few hours per week may not register for 15 credits per semester, or 1 credit per week.

The University takes the position that the facilities of the Graduate School should be made available only to the student who can profit from his graduate school experience to a maximum extent. Therefore the Graduate School reserves the right to deny admission or registration to part-time students who (a) propose schedules of few credits which seem to reflect little real interest in graduate work or would not seem to require serious effort, or (b) wish to carry overloads of such proportions as to handicap them seriously in achieving maximum quality in their graduate work.

A part-time student who is a graduate assistant or an employee of the University is governed by the following load schedules:

ACADEMIC DEGREES

EMPLOYMENT OR SERVICE LOAD		CREDIT LOAD ALLOWED	
<i>Hours per Week</i>	<i>Fraction of Full Time</i>	<i>Credits</i>	<i>Fraction of Full Load</i>
0	0	15	5/5
10	1/4	11-13	4/5
20	2/4	8-10	3/5
30	3/4	6- 8	1/2
40	4/4	6	2/5

The considerations leading to the establishment of this "protective" schedule of permitted loads for assistants and employees apply equally to part-time students employed off-campus.

AUDITING OF COURSES—No student is permitted to attend a class as an auditor unless he has registered officially for the course. Registration as an auditor follows the same procedure as registration for credit. Normally a student is required to count the courses audited as a part of his normal graduate load. However, a student who has demonstrated his ability to do superior work while carrying a normal graduate program (which is determined by his status as a full-time student, or as a part-time student employed on the campus or elsewhere) may, with the approval of the Dean, register for "audits" in addition to his normal credit load. To secure such approval the student should present to the Dean written evidence that the instructor of the "audit" course will accept him as an auditor, and that his adviser and the head of the department employing him (if he be employed) approve the extra load.

GRADUATION—It is the responsibility of the student to fill out a diploma card at the beginning of the semester or session at the end of which he expects to receive an advanced degree.

All degrees conferred are tentative until final grade reports have been received even though the student's name may have appeared in the printed commencement program.

Attendance at commencement exercises is an obligation on the part of those receiving advanced degrees. A request to receive the degree *in absentia* may be presented to the Dean of the Graduate School, but only under extraordinary circumstances will it be granted.

Degrees are normally granted at the end of each semester and at the end of the Main Summer Session.

ACADEMIC DEGREES

MASTER OF ARTS AND MASTER OF SCIENCE

These two degrees have similar requirements, the particular degree conferred upon the student being determined by the general area in which his major field is situated.

ADMISSION—Adequate undergraduate preparation is required in the field in which the applicant expects to pursue advanced work. The specific courses

DOCTOR OF PHILOSOPHY

and the total number of undergraduate credits required in various areas will be determined by the choice of field and can be ascertained from the Dean of Admissions. An applicant who meets the minimum grade point average but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A program for the master's degree requires a minimum of 30 credits and consists of a major and either a minor or a group of general studies. A minor consists of not less than 6 credits of integrated or articulated work in one field related to but different from that of the major. A general studies group consists of 6 credits in fields other than that designated as the major field considered by the major department to have significance and value for the candidate.

The program requires the equivalent of at least one academic year (two semesters), and may be met by full-time residence, part-time work, attendance in the summer sessions, or by any combination of these. Many students find that adequate programs leading to the master's degree involve considerably more than 30 credits and require more than one year's work. Ten credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State University may, under certain conditions, be offered in partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A minimum of 12 credits in course work, as contrasted with research, must be completed in the major field and at least 6 credits must be devoted to a thesis. At least 18 credits in graduate courses (500 series) and thesis research combined must be offered toward the fulfillment of minimum requirements for the degree. A student's program must be approved by his adviser and the Dean.

In addition to the above general requirements, major departments may set up specific course and subject-matter requirements for students working in their area.

The mere completion of a stated amount of work does not entitle a student to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS—Under the direction of the department in which the student's major subject is taken, he must prepare a thesis upon a suitable topic related to that subject. Under certain conditions a student may be permitted to complete the thesis *in absentia*. To obtain such permission he must make satisfactory arrangements in advance both with the major department and with the Dean.

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced by (1) the satisfactory completion of a prescribed period of study and investigation, (2) the preparation of a thesis involving independent research,

DOCTOR OF PHILOSOPHY

and (3) successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State University in regular semesters. During at least two semesters, if he be a part-time student, the candidate is expected to limit his work load to half-time at most and to devote the balance of his time to his graduate program. A minimum of three academic years of full-time graduate study and research, or their equivalent, is required for the attainment of a doctor's degree. The equivalent of two academic years may be secured by residence at another institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and thesis requirements within the period of one academic year on this campus.

Subject to the approval of his adviser, the head of his major department, and the Dean of the Graduate School, a student may register for research to be done off-campus. Such work will not be approved, however, simply because the arrangement is convenient for the student; scholarly considerations must determine the choice of location.

A student devoting only a portion of his time to his program will be credited on his residence requirements in proportion to the time actually spent in graduate study and research.

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The program shall consist of such a combination of courses and research as is approved by the doctoral committee for each individual student, and includes a major and either a minor or a group of general studies. Approximately two-thirds of the total time is to be devoted to the major field. A minor consists of not less than 15 credits, including those applied toward the master's degree, of integrated or articulated work in one field related to but different from that of the major. A general studies group consists of not less than 15 credits, including those applied toward the master's degree, in fields other than that designated as the major field considered by the major department to have significance and value for the candidate.

The first year of graduate study leading to the doctor's degree may be substantially the same as that provided for the master's degree and may lead to that degree, although that is not necessary.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Philosophy must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of graduate work (including work done for the master's degree and work done elsewhere as well as here). A student transferring from another graduate school must take this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department. If the student passes the examination, and in the opinion of the

PROFESSIONAL DEGREES

graduate faculty of his major department is qualified to follow a doctoral program, he is admitted to candidacy.

After a student has been admitted to candidacy the Dean will appoint, upon recommendation of the head of the major department, his doctoral committee which will thereafter guide him in candidacy.

For the Doctor of Philosophy degree, candidates are required to have a reading knowledge of at least two foreign languages. German and French are the languages most often needed. Other languages may be presented instead of these if their choice is determined by scholarly and professional reasons. The choice of a language must be approved by the major department. If a language other than English, French, German, Italian, Spanish, or Russian is presented, it must be approved also by the Dean of the Graduate School. A student may not present his mother tongue as one of the two languages required in candidacy. Candidates may present certification of having passed equivalent language examinations in other institutions in lieu of repeating the examinations. For further details, see the *Manual for Graduate Students*.

When a doctoral candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether he has adequate mastery of the subject matter to entitle him to proceed to the completion of a thesis. The candidate must have satisfied the language requirements before taking this examination.

A doctoral candidate who has satisfied all other requirements for the degree will be scheduled, on recommendation of the doctoral committee, to take a final examination. In no case may the final examination be scheduled less than three months after the comprehensive examination. The final examination is oral, open to the public, related in large part to the thesis, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

THESIS—The ability to do independent research must be proved by the preparation of a thesis on some topic related to the major subject. It should represent a significant contribution to knowledge, be presented in a scholarly manner, reveal on the part of the candidate an ability to do independent research of high quality, and indicate considerable experience in using a variety of research techniques. The contents and conclusions of the thesis must be defended at the time of the final examination.

The general subject of the thesis must be determined at the time of admission to candidacy for the degree, and the completed thesis, typewritten in triplicate, must be filed in the office of the Dean of the Graduate School not later than one week prior to the commencement at which the candidate expects to receive the degree.

PROFESSIONAL DEGREES MASTER OF EDUCATION

In order to provide programs of advanced work which would utilize more fully the professional training and background of those holding bachelor's degrees from teachers colleges and schools of education, two professional degrees in education were established.

MASTER OF EDUCATION

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership in educational work, and ability to solve concrete problems in at least one special field of educational activity.

ADMISSION—An applicant is required to have had at least 27 undergraduate credits in the field of education, including practice teaching, except that under certain circumstances this rule may be waived for a student working for the Doctor of Education degree with a major in higher education. An applicant choosing a major outside the fields of education (such as mathematics, geography, or history) will be expected to have in addition an adequate undergraduate preparation in the field of specialization. The specific course requirements and the total number of undergraduate credits required in the various areas will be determined by the choice of field and can be ascertained from the Dean of Admissions. An applicant who meets the minimum grade point average for admission but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A minimum of 30 credits is required, of which 6 may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters) and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Ten credits earned in residence at another approved institution or in extension classes of The Pennsylvania State University may, under certain conditions, be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A minimum of 24 credits must be earned in graduate course work. The larger part of this work shall be in courses open only to graduate students, but the needs of the student shall be considered in arranging the best combination of courses (400 and 500 series) for the preparation of the candidate in his special field. The degree program must be approved by the student's adviser or advisory committee.

When the student chooses a group major, his study program will be approved by a standing committee (or its representatives), which committee will foster the student's interests and stand in the same relation to him as does a department in the case of a student with a specific major. Such standing committees have been appointed in the broad fields of biological science, physical science, and social studies.

If a thesis is included in the program, it must be done under the direction of a supervisor representing either a major department or a standing committee supervising group majors. An amount of time equivalent to six credits may be devoted to research and the preparation of the thesis. Under certain conditions this may be carried out in part *in absentia*, particularly when requirements are met by summer session attendance.

Those candidates who do not elect to write a thesis are required to present an essay or term paper. It must be of considerable proportion, giving evidence of their capacity to describe a serious intellectual experience in writing, and giving unmistakable evidence of ability to formulate and state meaningfully

DOCTOR OF EDUCATION

the purpose of an investigation, study, critical analysis or evaluation, to acquire and analyze information, to draw conclusions logically, and to relate findings to professional problems and practices. The particular nature and extent of such a piece of writing (whether it be required in connection with a course or independently of course work), and when it is to be undertaken, shall be determined by the major department.

MAJOR AND MINOR FIELDS—If a student looks forward to a career as a teacher, he may choose a major outside the fields of education (such as English, mathematics, or geography) and take the majority of his work in that field. In this case the student is required to have a minor consisting of not less than 6 credits in basic education (includes comparative education, educational measurements and statistics, educational psychology, history of education, and philosophy of education). If he can demonstrate by examination an adequate background in basic education, he may choose a minor in any field of education.

If a student wishes to work in a broader field, a group major such as social studies, physical science, or biological science may be chosen. In this case at least 24 credits are to be devoted to the group, and 6 credits to a minor in basic education. It is expected that each student will choose one subject of the group as a field of primary interest, to which at least 12 credits are to be devoted.

If a student looks forward to a career as an administrator, a guidance counselor, or a supervisor, he may specialize in one of the fields of education and choose that as his major. In this case the student is required to have a minor consisting of not less than 6 credits in either a field outside of education or in basic education as defined above.

EXAMINATIONS—A candidate for the Master of Education degree must pass a final comprehensive examination. The examination will be designed to determine the ability of the candidate to apply the general as well as the special knowledge of his chosen field in practical situations.

A candidate majoring in education is required to take a departmental qualifying examination, comprehensive in scope, before completing the second half of his course requirements. This serves as a guide in outlining a program of study that will fit his individual needs.

DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced (1) by the satisfactory completion of a prescribed period of study; (2) by the application of scientific principles in classroom teaching, in the supervision of instruction, or in administrative work; (3) by the preparation of a thesis demonstrating ability to undertake an educational problem with originality and independent thought; (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects; and (5) by recognized leadership in the profession of education.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State University. This requirement may be met by attendance at summer sessions, although there is no guarantee that it

will be possible to do so in all cases. An equivalent of three years of graduate study is required as a minimum for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

The equivalent of two full years of work may be secured by residence at another institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and thesis requirements within the period of one academic year on this campus. Credit for courses and research work done elsewhere can be used to meet degree requirements only if appropriate to the candidate's proposed program of study as determined by his doctoral committee.

One third of the requirements (equivalent to a 30-credit year) for the degree may be met by research work pursued away from the campus in the school systems of the State, or in other approved centers, provided (1) the plan be approved by the candidate's doctoral committee, (2) reports on the projects be made as directed by this committee, (3) not more than 6 credits be earned in a semester, and (4) the arrangement be approved by the Dean.

Work done off the campus which is to be credited toward a doctor's degree must be scheduled *in advance*, following regular registration procedure.

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a period of residence, a satisfactory thesis, the passing of comprehensive examinations, and possession of the qualities of professional leadership. A program shall consist of such a combination of courses and individual study and research as is approved by the doctoral committee for each candidate. The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement must be in the major field of study.

A candidate choosing a major outside the fields of education (such as chemistry, English, or history) shall have a minor consisting of not less than 15 credits, including those applied toward the master's degree, in psychology and basic education (includes comparative education, educational measurements and statistics, educational psychology, history of education, and philosophy of education).

A candidate choosing a major in one of the fields of education must also choose either a minor or a group of general studies with the approval of the major department. In this case a minor consists of not less than 15 credits, including those applied toward the master's degree, in one field outside the fields of education. An acceptable general studies group consists of not less than 15 credits, including those applied toward the master's degree, in fields outside the fields of education considered by the major department to have significance and value for the candidate. Every candidate must show through comprehensive examinations that he is familiar with current theories of education, that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject, that he is prepared to read understandingly and contribute to the technical and professional literature in his field, and that he can criticize his own procedures in the light of historical trends and practices in this and other countries. Com-

DOCTOR OF EDUCATION

mand of the tools for a thorough study of the problems of education is necessary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Education must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of graduate work (including work done for the master's degree and work done elsewhere as well as here). A student transferring from another graduate school must take this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department.

Three of the important factors taken into consideration in passing judgment upon admission to candidacy are:

1. Previous scholastic record at this institution and other institutions attended.
2. Achievement in qualifying examinations.
3. Estimates of the student's personal and professional qualifications by the graduate faculty of the major department.

After a student has been admitted to candidacy, the Dean, upon recommendation of the head of the major department, will appoint his doctoral committee which will thereafter guide him in candidacy.

When the candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether or not he is to be permitted to proceed to the completion of his thesis. This examination will be designed to test (1) the candidate's general scholastic preparation and professional background, and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

A candidate who has fulfilled all other requirements for the degree will, on recommendation of his doctoral committee, be permitted to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's doctoral committee and others appointed by the Dean of the Graduate School. In no case may the final examination be scheduled less than three months after the comprehensive examination. The final examination will be based largely upon the thesis, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

THESIS—Evidence of a high degree of scholarship and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written thesis. The candidate must demonstrate capacity for independent thought as well as ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed thesis must have the approval of the doctoral committee.

MASTER OF FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for additional study in a student's particular field of interest rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

ADMISSION—An applicant for admission is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission, they must be removed early in the program. While making up deficiencies in prerequisite credits, the student must follow a program approved by his advisory committee. Deficiencies in the 1.5 grade point average will lead to refusal of admission to the Graduate School.

REQUIREMENTS—A minimum of 30 credits is required for the degree of Master of Forestry. It is expected that the larger part of the program shall be in graduate courses, but no specific number of credits in the 500 series is required. A thesis representing a minimum of 6 credits must be prepared. Under certain conditions a student may be permitted to complete the thesis *in absentia*. To obtain such permission he must make satisfactory arrangements in advance both with the head of the department and with the Dean. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A maximum of 10 credits earned in extension classes of The Pennsylvania State University or in resident classes of other approved institutions may, under certain conditions, be applied toward the degree provided they fit into the program of the student.

A student should choose one field of work for his major interest, with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with the student's advisory committee.

TECHNICAL DEGREES

ADMISSION—A graduate of the College of Chemistry and Physics, of the College of Engineering and Architecture, or of the College of Mineral Industries of The Pennsylvania State University may be admitted to work for a technical degree, provided he submits evidence of having been engaged for a period of not less than three years in acceptable professional work in the field of engineering in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in engineering in a professorial rank in this institution, and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees. An applicant who is eligible for a technical degree is admitted to the Graduate School by the Dean of Admissions.

GENERAL INFORMATION — FEES

An applicant for a technical degree must file with the Dean of Admissions an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the admission fee of \$5.

Registration for these degrees is the same as for resident students. A candidate must be registered during two regular semesters.

DEGREES AND REQUIREMENTS—The technical degrees are as follows: Aeronautical Engineer, Architectural Engineer, Chemical Engineer, Civil Engineer, Electrical Engineer, Fuels Engineer, Industrial Engineer, Ceramic Engineer, Mechanical Engineer, Engineer of Mines, Metallurgical Engineer, Petroleum Engineer, and Sanitary Engineer.

Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his application for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate College concerned.

In order to be recommended for a technical degree, the candidate must prepare a thesis on a subject related to his profession. He must register in the manner specified in the foregoing section and pay the registration and graduation fees. He may be required to appear in person to defend his thesis.

THESIS—Immediately following registration the candidate must submit for approval an outline of his proposed thesis; and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

GENERAL INFORMATION

FEES—

REGULAR FEES, PAID EACH SEMESTER:

Students registered for 12 or more credits:

Residents of Pennsylvania	\$120.00
Nonresidents of Pennsylvania, on-campus studies	245.00
Nonresidents of Pennsylvania, off-campus research	120.00

Students registered for fewer than 12 credits:

Residents of Pennsylvania, per credit	11.00
Nonresidents of Pennsylvania, on-campus studies, per credit	21.00
Nonresidents of Pennsylvania, off-campus research, per credit	11.00

Graduate assistants, fellows, and scholars:

Health and welfare charge	18.00
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LIVING ACCOMMODATIONS

SPECIAL FEES, PAID AS OCCASION DEMANDS:

Applicable to all students, including graduate assistants, fellows, and scholars:

Admission to the Graduate School	5.00
Privilege of late registration or late payment	10.00
Change of schedule, each change	2.00
Publication of doctoral thesis abstract	35.00
Official transcript of record (with seal), each copy	1.00

The University reserves the right to revise fees without further notice.

With reference to fees, courses that are scheduled for audit are considered the same as though they were scheduled for credit.

Summer sessions students who register for graduate courses pay the regular fees for the summer sessions.

Whenever it shall appear from any of the data presented as part of the application for admission that the applicant is not domiciled in Pennsylvania, the Dean of Admissions, when admission is granted to that applicant, assumes that he is a non-Pennsylvanian and includes that admission as part of the established out-of-State quota.

If an entrant, classed as out-of-State, believes that his circumstances do not justify his classification as a non-Pennsylvanian, he may petition the Dean of Admissions for reclassification.

Whenever such a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous domicile of the one admitted (or of his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding his admission, and, in addition, such other evidence as may appear pertinent to a complete review of his classification.

Any student who does not fulfill payment obligations promptly may be charged \$1 for each day of delinquency up to and including five days, or a maximum of \$10 if the delinquency exceeds five days. A student whose account is delinquent for more than 10 days is subject to suspension from the University.

LIVING ACCOMMODATIONS—A variety of living accommodations are available including rooms in private homes, lodging houses, and to a limited extent in University residence halls. Boarding houses and restaurants are available for meals. The cost varies considerably but has been estimated at approximately \$21 per week, including both board and room. The office of the Dean of Men and the office of the Dean of Women attempt to maintain a list of known vacancies. The prospective student should write to the appropriate office well in advance of the beginning of school because it may be very difficult to find a convenient location at the last minute.

A married student may find accommodations in apartments, trailers, and rooms in private homes. Personal contact is essential, but assistance may be gained through contact with the office of the Dean of Men or an advertisement in the local newspaper.

GRADING SYSTEM

A married student is eligible for residence in Eastview Terrace, a housing development consisting of small one- or two-bedroom units located on the campus. For details write to the Director of Housing, Old Main.

GRADING SYSTEM—A grade is given to a student solely on the basis of the instructor's judgment as to his scholarly attainment.

For graduate courses (500 series) one of three grades may be given:

H for Honors, indicating definitely superior attainment.

P for Pass, indicating acceptable but not superior attainment.

F for Fail, indicating failure to attain the minimum standards of work acceptable for credit in a degree program.

For research or thesis one of four grades may be given:

H for Honors, indicating definitely superior attainment.

P for Pass, indicating acceptable but not superior attainment.

F for Fail, indicating failure to spend an appreciable amount of time doing the scheduled work or failure to attain the minimum standards of work acceptable for credit in a degree program.

R for Research, indicating that the investigation is continuing and that the student has devoted an adequate amount of time to the work scheduled but that the supervisor does not want to give a quality grade (H, P, or F) at this point. When the project is completed an H, P, or F must be given and will be considered the quality grade for the entire research. Grades of R given while the research was in progress will remain on the student's record permanently.

For 400 series courses one of six grades may be given:

3—90 to 100 inclusive

2—80 to 89 inclusive

1—70 to 79 inclusive

0—60 to 69 inclusive

—1—45 to 59 inclusive

—2— 0 to 44 inclusive

Grades below 2 do not carry graduate credit.

HEALTH SERVICE—The University Health Service is available to any graduate student who registers for 12 or more credits or who holds an appointment as a fellow, a graduate assistant, or a scholar. This service endeavors to conserve, maintain, and promote the health of students. Consult the *Manual for Graduate Students* for details concerning its facilities and services.

PLACEMENT SERVICE—The University Placement Service is designed to co-ordinate the placement activities of all the Colleges and the Graduate School. The services of the following divisions are available to the student without charge.

The Placement Service functions primarily as a clearing house, bringing together students, alumni, faculty members, and representatives of organizations that are seeking college-trained personnel. Summer jobs other than those at camps or resorts are listed at this office.

The Teacher Placement Division is maintained to assist seniors, alumni, and graduate students in all departments in securing teaching positions for which they are qualified.

The Student Employment Division offers assistance to students in finding part-time employment in town and on the campus, as well as summer employment at camps and resorts. A student must be registered to be informed of jobs.

The divisions of the University Placement Service are available to any student, regardless of level, who is in need of counseling or guidance on employment problems.

RELIGIOUS ORGANIZATIONS—The University seeks to serve the spiritual needs of its students and staff. General responsibility for religious activity on the campus rests with the University Chaplain and Co-ordinator of Religious Affairs. Individual organizations under the sponsorship of members of the Jewish, Protestant, and Roman Catholic faiths serve the student body. Many other religious organizations, including denominational and interdenominational groups, are active on the campus and in association with local churches.

SELECTIVE SERVICE—The University attempts to keep local draft boards fully informed in regard to the status and progress of all students who are subject to Selective Service regulations. Responsibility for this matter is placed in the Office of the Assistant Registrar, and all communications between University staff members and local boards are cleared through this office. As soon as an applicant has been admitted to the Graduate School, his local board will be so informed provided the applicant has given the necessary information.

SENIOR STUDENT PRIVILEGES—A senior student of The Pennsylvania State University lacking not more than 4 credits for graduation may be admitted to the Graduate School. A senior student in his last semester lacking more than 4 credits for graduation may not be admitted to the Graduate School but may be admitted to graduate courses (500 series) upon approval of the Dean of his College and the Dean of the Graduate School.

SUMMER SESSIONS—A series of sessions covering a total period of 12 weeks are arranged each summer. During this time there are excellent opportunities for graduate work in many fields. Detailed information can be secured from the *Summer Sessions Complete Announcement*, which is published about April 1 and may be obtained by writing to the Director of Summer Sessions.

It is the aim of the University to make available its staff and resources during the summer to aid students to the fullest possible extent in their programs of graduate study and research. The University cannot guarantee, however, that all the services normally offered during the academic year will be at hand during the summer.

To avoid disappointments, a student who plans to present a thesis for final consideration or to take the final doctoral examination during the summer sessions should inform the chairman of his committee and the head of his department of his intentions prior to June 1. A notice of approval will be sent to the student if the necessary staff members will be available to provide the service requested.

A graduate student desiring to carry forward a special graduate program or research project not officially listed as a part of the Summer Sessions should, likewise, obtain written approval of his plans from the chairman of his committee and the head of his department prior to June 1.

ASSISTANTSHIPS, FELLOWSHIPS, AND OTHER AIDS

ASSISTANTSHIPS—A number of graduate assistantships are available to students who show promise of superior ability to carry on graduate study. An appointee may serve as an assistant in classroom or laboratory instruction, or in research or office work. His appointment may be for the academic year or for the fiscal year. Exemption from all major fees and charges is granted, but the student must pay the health and welfare charge as well as such specific fees as admission, late registration, and change of schedule. Privileges for a graduate assistant appointed for the academic year do not extend into any of the summer sessions. A veteran holding an assistantship is not in general eligible for full benefits from the Veterans Administration.

An appointee may not accept additional employment, either at the University or elsewhere, during the period for which service to the University is required under the appointment. A graduate assistant appointed for the fiscal year is permitted an allowance for time off with pay, including vacation and sick leaves, equivalent to 30 calendar days per year, the vacation to be scheduled at the convenience of the department. Vacation for a graduate assistant on appointment for the academic year consists of the regular student vacations available to graduate students, or an equivalent amount of time off during the academic year at the convenience of the department.

A student holding a quarter-time or a half-time assistantship is considered to be following a full-time course of instruction under Selective Service regulations and is certified to his local draft board as a full-time student.

Prospective students should write directly to the head of their major department for information and application forms. Appointments are made upon the recommendation of the department head, subject to admission to the Graduate School and to the approval of the Dean of the Graduate School. Clear evidence of superior ability and promise is required. Reappointment to an assistantship requires a continuing demonstration of good scholarship.

The three types of graduate assistantships vary in stipend, service required, and the number of credits for which the student may register. Not all types will be available in every department.

QUARTER-TIME, requiring about 10 hours of service per week.

For the academic year: Stipend \$590; 11-13 credits per semester.

For the fiscal year: Stipend \$780; 11-13 credits per semester, 8-10 credits in summer sessions.

HALF-TIME, requiring about 20 hours of service per week.

For the academic year: Stipend \$1180; 8-10 credits per semester.

For the fiscal year: Stipend \$1572; 8-10 credits per semester, 6-8 credits in summer sessions.

THREE-QUARTER TIME, requiring about 30 hours of service per week.

For the academic year: Stipend \$1770; 6-8 credits per semester.

For the fiscal year: Stipend \$2352; 6-8 credits per semester, 5-6 credits in summer sessions.

COUNSELORSHIPS—The Dean of Men has available a number of appointments as resident counselors in the men's residence halls. Their responsibility is to work for the social, academic, and emotional adjustment of the undergraduate residents. Specialized training in personnel work is desirable, though not essential.

These appointments are for the academic year and carry with them remission of fees for room and board, but not exemption from academic fees.

Applications should be addressed to the Dean of Men.

FELLOWSHIPS—Approximately 80 fellowships are available to enable superior graduate students to devote all their time to study and research. Fellowships render no service, though in some cases they will be expected to conduct their research within broad fields specified by the donors. They will be expected to register for full-time graduate programs and not to accept additional employment. Fellowships yield stipends in varying amounts and carry with them exemption from the major fees, but not from the health and welfare charge and other specific fees such as admission, late registration, and change of schedule.

Requests for additional information and application forms should be addressed to the head of the major department concerned.

The fellowships which are available will vary somewhat from year to year, but the following are typical of those which were awarded for 1954-55:

ALLEGHENY LUDLUM FELLOWSHIP—Open to graduate students in metallurgy for studies in steelmaking.

ALLIED CHEMICAL AND DYE FELLOWSHIP—Open to graduate students in chemical engineering.

ALLIED CHEMICAL AND DYE FELLOWSHIP—Open to graduate students in organic chemistry for the final year of study leading to the Ph.D. degree.

AMERICAN PETROLEUM INSTITUTE FELLOWSHIPS (8)—Open to graduate students in chemistry and physics for research concerning the synthesis and properties of high molecular weight hydrocarbons.

ANTHRACITE FELLOWSHIP—Open to graduate students in fuel technology for studies on anthracite.

CALIFORNIA COMPANY FELLOWSHIP—Open to graduate students in geology and mineralogy for studies in sedimentary petrology or stratigraphy.

CARNEGIE GRADUATE FELLOWSHIPS (3)—Open to advanced level graduate students.

CONTINENTAL OIL COMPANY FELLOWSHIP—Available to graduate students in petroleum and natural gas engineering for studies in petroleum engineering.

CO-OPERATIVE PROGRAM FELLOWSHIP—Open to graduate students in metallurgy.

DANFORTH FOUNDATION FELLOWSHIPS—For graduate students in the natural sciences, social sciences, humanities, and other fields of specialization preparing themselves for college teaching, who see in teaching a vocation of Christian service.

DOW CORNING FELLOWSHIPS—Open to graduate students in chemistry for fundamental studies in organosilicon compounds.

FELLOWSHIPS

DU PONT TEACHING FELLOWSHIP IN CHEMISTRY—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

DU PONT FELLOWSHIP IN MECHANICAL ENGINEERING—Open to graduate students in mechanical engineering, preferably those working toward the Ph.D. degree.

EDWARD ORTON, JR., CERAMIC FOUNDATION FELLOWSHIP—Open to graduate students in ceramics for studies relating to kiln-fired ceramic bodies.

ELI LILLY FELLOWSHIPS (2)—Open to graduate students in physics for studies in crystal analysis.

ELLIOTT FELLOWSHIP IN ENGINEERING RESEARCH—An annuity provided by W. S. Elliott of Pittsburgh for a student in engineering who must be a graduate of this University.

FARM BUREAU POULTRY NUTRITION FELLOWSHIP—For the support of research in poultry nutrition, with major interest in biochemistry.

GULF COMPANY FELLOWSHIP IN MINERALOGY—Open to graduate students in mineralogy for studies in sedimentation.

GULF COMPANY FELLOWSHIP IN MINING—Open to graduate students in mining engineering for studies in underground rock structures.

GULF COMPANY FELLOWSHIP IN PHYSICS—In support of graduate work in the field of X-ray crystallography.

HAMILTON STANDARD FELLOWSHIPS (3)—Open to graduates of this University in aeronautical engineering, electrical engineering, and mechanical engineering.

KENNECOTT COPPER CORPORATION FELLOWSHIP IN GEOPHYSICS—Open to graduate students in geophysics for studies relating to mining geophysics.

PENNSYLVANIA CO-OPERATIVE POTATO GROWERS ASSOCIATION FELLOWSHIP—In support of research concerning soil and fertility factors affecting yields and quality of potatoes.

PENNSYLVANIA CO-OPERATIVE WILDLIFE RESEARCH FELLOWSHIPS (3)—Funds supplied by the Pennsylvania Game Commission for investigations dealing with wildlife management.

CO-OPERATIVE GRANGE LEAGUE FEDERATION FELLOWSHIP—For the support of research in poultry nutrition, with major interest in biochemistry.

PITTSBURGH CONSOLIDATION COAL COMPANY FELLOWSHIP—Open to graduate students in fuel technology for research leading to the Ph.D. degree.

ST. JOSEPH LEAD COMPANY FELLOWSHIP—Open to graduate students in metallurgy for studies in chemical metallurgy.

SHELL COMPANY FELLOWSHIP IN CHEMICAL ENGINEERING—In support of graduate work in chemical engineering, preferably for students in their last year of doctoral work.

SHELL COMPANY FELLOWSHIP IN CHEMISTRY—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

SINCLAIR FELLOWSHIP IN PETROLEUM PRODUCTION—Available to graduate students in petroleum and natural gas engineering for studies in petroleum production.

STACKPOLE FELLOWSHIP—Open to graduate students in fuel technology for studies on carbon.

STACKPOLE FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy for studies in powder metallurgy.

STANOLIND FELLOWSHIP IN PETROLEUM AND NATURAL GAS ENGINEERING—Available to graduate students in petroleum and natural gas engineering for studies in petroleum production.

TITAN METAL FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy for studies on copper-base alloys.

UNION CARBIDE AND CARBON FELLOWSHIP—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

UNION CARBIDE AND CARBON FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy for studies in powder metallurgy.

U. S. PUBLIC HEALTH FELLOWSHIPS (3)—Open to graduate students in clinical psychology.

WEIRTON FELLOWSHIP—Open to graduate students in metallurgy for studies in steelmaking.

JOHN W. WHITE FELLOWSHIPS—Awarded to two graduates of The Pennsylvania State University each year on the basis of scholarship, need, character, and attitude. The recipients may enroll in any approved college or university.

In addition, numerous grants are available from governmental agencies, industrial concerns, and foundations for the support of investigations of particular problems. Many of these permit full-time study and carry the same fee exemptions as the fellowships listed above. Detailed information can be secured from departments.

LOAN FUNDS—Loan funds are available to a limited extent. Applications should be addressed to the Dean of Men or the Dean of Women.

SCHOLARSHIPS—A number of scholarships are awarded annually. Applications should be addressed to the Dean of the Graduate School and must be received by March 1 in order to be considered for the following academic year.

GRADUATE SCHOLARSHIPS—Forty are awarded each year. These scholarships carry no stipend but do grant exemption from all major fees. Recipients are required to take a full program of graduate work and may be required to render some service.

A.A.U.W. SCHOLARSHIP—The State College Branch of the American Association of University Women has established a scholarship for a woman graduate student. The amount of the award varies and does not include fee exemption.

STUDENT EMPLOYMENT—Many students depend partly on their own earnings to help meet their expenses. The Student Employment Office, 112 Old Main, gives information on part-time jobs. A student not holding an assistantship, fellowship, or scholarship who wants a part-time job should register with the Student Employment Office as soon as his class schedule has been arranged. While some students find regular part-time work, many of them depend on a series of odd jobs, some of which are of a continuing nature.

VETERANS BENEFITS

VETERANS BENEFITS—The Co-ordinator of Veterans Affairs is charged with the responsibility of handling all applications for benefits under the various Public Laws.

Under P.L. 346 a student is required by the Veterans Administration to schedule a minimum of 12 credits in order to be considered a full-time student.

Under P.L. 550 the responsibility for classifying students as to their rate of training rests with the Dean of the Graduate School. The classification is based on the extent to which the student devotes himself to his graduate program (as contrasted with the service for which he receives remuneration) and is not directly determined by the number of credits scheduled. Thus a student who is employed about 20 hours per week and devotes the remainder of his time to graduate work would be considered a half-time student on the basis of his employment regardless of how many credits he was permitted to schedule.

GRADUATE COURSES

COURSE ABBREVIATIONS

Acctg.	Accounting	Hl.Ed.	Health Education
Aero.E.	Aeronautical Engineering	Hist.	History
A.B.Ch.	Agricultural and Biological Chemistry	H.Art	Home Art
Aggr.Ec.	Agricultural Economics	H.C.Rel.	Home-Community Relationships
Aggr.Ed.	Agricultural Education	H.E.Ed.	Home Economics Education
Aggr.E.	Agricultural Engineering	H.Mgmt.	Home Management and Family Economics
Aggr.	Agriculture—General	Hort.	Horticulture
Agro.	Agronomy	Hl.Adm.	Hotel Administration
A.H.	Animal Husbandry	Hs.Eqp.	Housing and Home Equipment
A.Ntr.	Animal Nutrition	I.Arts	Industrial Arts
Anthy.	Anthropology	Ind.Ed.	Industrial Education
Archy.	Archaeology	I.E.	Industrial Engineering
A.E.	Architectural Engineering	In.Adm.	Institution Administration
Arch.	Architecture	Int.Un.	International Understanding
Art	Art	It.	Italian
Art Ed.	Art Education	Journ.	Journalism
Astro.	Astronomy	Latin	Latin
Bact.	Bacteriology	Lib.Sc.	Library Science
Bot.	Botany	Math.	Mathematics
B.Stat.	Business Statistics	M.E.	Mechanical Engineering
Cer.	Ceramics	M.E.Des.	Mechanical Engineering Design
Ch.E.	Chemical Engineering	M.E.Lab.	Mechanical Engineering Laboratory
Chem.	Chemistry	Met.	Metallurgy
Ch.Fm.	Child Development and Family Relationships	Meteo.	Meteorology
C.E.	Civil Engineering	Min.Ec.	Mineral Economics
Cl.Tex.	Clothing and Textiles	M.I.	Mineral Industries
Com.	Commerce	Min.Pr.	Mineral Preparation
C.Con.S.	Commercial Consumer Services	Min.Sc.	Mineral Sciences
C.Lit.	Comparative Literature	Min.	Mineralogy
D.Sc.	Dairy Science	Mng.	Mining
Dram.	Dramatics	Music	Music
Econ.	Economics	Mus.Ed.	Music Education
Ed.	Education	Pet.E.	Petroleum and Natural Gas
E.E.	Electrical Engineering	Phil.	Philosophy
El.Lab.	Electrical Engineering Laboratory	Ph.Ed.	Physical Education
Eng.	Engineering	Phys.	Physics
Mchs.	Engineering Mechanics	Pol.S.	Political Science
Engl.	English	Port.	Portuguese
E.Cmp.	English Composition	P.H.	Poultry Husbandry
E.Lit.	English Literature	Psy.	Psychology
Ent.	Entomology	P.U.	Public Utilities
Fd.Ntr.	Foods, Nutrition, and Health	Recr.	Recreation
For.	Forestry	R.Soc.	Rural Sociology
Fr.	French	Rus.	Russian
Fuel T.	Fuel Technology	Soc.	Sociology
Gen.H.E.	General Home Economics	Sp.	Spanish
Geog.	Geography	Spch.	Speech
Geol.	Geology	Sph.Ed.	Speech Education
G.G.	Geophysics and Geochemistry	Vet.Sc.	Veterinary Science
Ger.	German	Zool.	Zoology
Greek	Greek		

GRADUATE COURSES

NUMBERING SYSTEM

The course descriptions which follow are arranged alphabetically. If any course cannot be located readily, refer to the table of contents, pages 2 and 3. Courses are numbered as follows:

UNDERGRADUATE COURSES (1 to 399) are general courses accepted in fulfillment of the requirements for the bachelor's degree.

UPPER-CLASS AND GRADUATE COURSES (400 to 499) are advanced courses open for credit to undergraduate students of at least junior standing and to graduate students under the restriction that no more than 12 credits in these courses may be offered in fulfillment of the minimum requirements for the M.A. and M.S. degrees.

GRADUATE COURSES (500 to 599) are for graduate students only. The name of the instructor may follow the description. Seniors not required to carry a full program for graduation, with permission of the Dean of the College in which they are enrolled and of the Dean of the Graduate School, may attend such courses and be allowed credit under special conditions. *Many departments reserve the right to say which of certain graduate courses may be given in any semester; the heads of departments should be consulted.*

RESEARCH OR THESIS (600 and 610): In general, students registering for research or for work on a master's or a doctor's thesis will, if it is to be done in residence, use course number 600 preceded by the appropriate course abbreviation. Thus Aero.E. 600 signifies research or thesis in Aeronautical Engineering. In case such work has been authorized as off-campus work for nonresident students, the course number 610 will be used. Credits will be 1 to 15 per semester. There will be no specific listing of the 600 and 610 courses in the departmental listings.

EXPLANATORY NOTE: The figures in parentheses following the course title show the number of credits granted for that course. Many graduate courses are offered in the summer sessions. When these courses are also given during the regular academic year, they are not listed separately as summer session courses in this announcement. For a complete list of courses given during a specific summer session, consult the *Complete Announcement of the Summer Sessions* for that year. In the section which follows, courses given during the summer session (*but not during the regular academic year*) have numbers followed by the letter "S." Courses given in extension only have numbers followed by the letter "X."

A department may schedule an entire section in an undergraduate course for fewer credits than the maximum authorized. In 400 and 500 courses a department may schedule an individual student for fewer credits than the maximum authorized. In no case, however, may the total number of credits scheduled for any student exceed the maximum number authorized for the course.

ACCOUNTING

PROFESSOR CHARLES J. ROWLAND, C.P.A., M.B.A.

Head of the Department of Accounting and Business Statistics

500. ACCOUNTING SEMINAR (3) Prerequisite: Acctg. 6. *Professor Rowland*
 501. ACCOUNTING SYSTEMS (3) Principles of system design including practical application to special businesses, such as financial institutions, department stores, public utilities, etc. Prerequisite: Acctg. 401.
Professor Rowland

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 400. CONTROLLERSHIP (3) | <i>Professor Nelson</i> |
| 401. ADVANCED ACCOUNTING (3) | <i>Professor Devereaux</i> |
| 403. ADVANCED AUDITING (3-9) | <i>Professor Rowland</i> |
| 404. BUDGETARY CONTROL (3) | <i>Professor Nelson</i> |
| 405. ADVANCED COST ACCOUNTING (3) | <i>Professor Nelson</i> |
| 406. ADVANCED FEDERAL TAX ACCOUNTING (3) | <i>Professor Rowland</i> |
| 407. C.P.A. REVIEW (3) | <i>Professor Rowland</i> |
| 408. GOVERNMENTAL ACCOUNTING (3) | <i>Professor Rowland</i> |

AERONAUTICAL ENGINEERING

PROFESSOR HAROLD M. HIPSH, M.S., Ph.D.

Head of the Department

501. AIRPLANE STABILITY AND CONTROL (3) General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aero.E. 403.
 503. AIRPLANE PERFORMANCE (3) Methods of performance prediction and performance flight testing for high-speed aircraft and missiles. Prerequisite: Aero.E. 403.
 504. ROTARY WING AIRCRAFT (3) Types of rotary wing aircraft; helicopter performance, stability, and control; structural and vibration problems. Prerequisites: Aero.E. 403, 409.
 505. AIRCRAFT VIBRATION AND FLUTTER (3) Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending, torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aero.E. 1, M.E.Des. 8.
 506. ADVANCED AIRCRAFT STRUCTURES (3) Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing

AERONAUTICAL ENGINEERING

deformations of multi-cell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisite: Aero.E. 409.

- 507. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3) Types of jet propulsion installations, thermodynamic cycles, analysis of compressors, combustion chambers, and turbines. Prerequisite: Aero.E. 410.
- 510. AERODYNAMICS OF COMPRESSIBLE FLUIDS (3) One-dimensional motion, shock waves, flow in nozzles, two-dimensional flow, airfoil theory, Prandtl-Meyer flow, method of characteristics. Prerequisite: Aero.E. 412.
- 511. AERODYNAMICS OF A PERFECT FLUID (3) Euler's dynamic equations, complex potential, conformal transformation, thin airfoils, Biot-Savart law; Prandtl three-dimensional airfoil theory. Prerequisite: Aero.E. 412.
- 512. AERODYNAMICS OF A VISCOUS FLUID (3) Navier-Stokes equations, incompressible and compressible boundary layer theory, jet and wake problems, hydrodynamic stability, turbulence. Prerequisite: Aero.E. 412.
- 513. RESEARCH IN AERONAUTICAL ENGINEERING (1-15 per semester) Investigation of a theoretical or experimental project in aeronautical engineering.
- 514. AERONAUTICAL ENGINEERING SEMINAR (1 per semester) Current literature and special problems in aeronautical engineering.
- 515. AERODYNAMICS (3) Airflow, airplane performance. For students with undergraduate training in science or engineering curriculums other than aeronautical engineering.
- 516. AIRCRAFT STRUCTURES (3) Analysis of semi-monocoque aircraft structures. For students with undergraduate training in science or engineering curriculums other than aeronautical engineering.
- 517. DYNAMICS OF AIRCRAFT (3) Steady and transient vibrations, Laplace transformation, electrical analogies; introduction to flutter, dynamic stability, aeroelasticity, and servomechanisms.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401a,b,c. AERONAUTICAL ENGINEERING PROJECTS (2-12)
- 402. AIRPLANE ENGINE DESIGN (4)
- 403. APPLIED AERODYNAMICS (3)
- 404. AIRPLANE DESIGN (3)
- 407. ROTARY WING AIRCRAFT (3)
- 408. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3)
- 409. AIRPLANE DETAIL DESIGN (3)
- 410. AIRCRAFT PROPULSION (3)
- 411. AIRCRAFT STRUCTURES (3)
- 412. THEORETICAL AERODYNAMICS (3)
- 413. GUIDED MISSILES (3)

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

PROFESSOR HOWARD O. TRIEBOLD, M.S., Ph.D.

Head of the Department

501. ENZYMES (2) Investigations and theories concerning nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: A.B.Ch. 437. *Professor Jensen*
502. PHYSICAL CHEMISTRY OF THE CELL (3) Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: A.B.Ch. 426.
503. PROBLEMS IN RESEARCH (3-15) Prosecution of an assigned problem under the guidance of an instructor.
505. VITAMINS AND DIETARY DEFICIENCY DISEASES (2) Lectures, conferences, and assigned reading. Prerequisite: A.B.Ch. 437.
Professor Guerrant
506. VITAMIN ASSAY METHODS (2) Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: A.B.Ch. 505.
Professor Guerrant
- 507a. SEMINAR IN PHYSIOLOGICAL CHEMISTRY AND NUTRITION (1)
Professors Guerrant, Anderson, Boucher, Miller, and Pritham
- 507b. SEMINAR IN FOODS AND ANALYTICAL CHEMISTRY (1)
Professors Triebold, Althouse, and Shigley
- 507c. SEMINAR IN PLANT ENZYME, AND INSECTICIDE CHEMISTRY (1)
Professors Frear and Jensen
508. BIOCHEMICAL LITERATURE (1-3) Assigned readings, reports, and conferences on selected topics in biochemistry. Prerequisite: A.B.Ch. 437.
509. BIOCHEMICAL METHODS (3) Advanced laboratory course involving special methods used in biochemical research on plant and animal materials. Prerequisite: A.B.Ch. 437.
510. PROTEINS (2) Chemical constitution of proteins, their physical and biochemical properties, their function in nutrition, and their fate in metabolism. Prerequisite: A.B.Ch. 437. *Professor Anderson*
511. CARBOHYDRATES (2) Chemical constitution and properties of carbohydrates; their metabolism in plant and animal organisms. Prerequisite: A.B.Ch. 437. *Professor Jensen*
512. LIPIDS (2) Investigations on biochemistry of fats and related substances. *Professor Althouse*
513. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (4) Laboratory course, quantitative in nature, valuable as preparation for

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

A.B.Ch. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: A.B.Ch. 425 or Chem. 463.

515. BIOMETRY (2) Application of statistical methods to research problems in biochemistry and biology. Prerequisite: Agr. 400. *Professor Miller*

516. CHEMISTRY OF INSECTICIDES AND FUNGICIDES (2) Lectures and assigned readings dealing with chemical investigations of materials used in the control of insects and plant diseases. Prerequisites: Chem. 31; A.B.Ch. 425 or Chem. 461. *Professor Frear*

517. ENDOCRINE SECRETIONS (2) Chemistry of hormones and their physiological significance. Prerequisite: A.B.Ch. 437. *Professor Pritham*

518. MINERAL METABOLISM (2) Utilization and function of mineral elements in animal nutrition. Prerequisite: A.B.Ch. 437. *Professor Boucher*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

403. DAIRY CHEMISTRY (3) *Professor Shigley*

404. FOOD CHEMISTRY (4) *Professor Triebold*

413. PRINCIPLES OF ANIMAL NUTRITION (3) *Professor Miller*

417. METHODS OF AGRICULTURAL ANALYSIS (4) *Professor Triebold*

418. PLANT ANALYSIS (4) *Professor Jensen*

421. CHEMISTRY OF MILLING AND BAKING (3) *Professor Triebold*

425. BIOPHYSICAL CHEMISTRY (4)

426. BIOCOLLOIDS (3)

427. POTENTIOMETRIC THEORY AND TECHNIQUE (3)

437. GENERAL BIOCHEMISTRY (5) *Professor Pritham*

438. PHYSIOLOGICAL CHEMISTRY (CLINICAL METHODS) (5)

Professors Anderson and Pritham

439. PROBLEMS IN AGRICULTURAL CHEMISTRY (3-5)

440. PLANT BIOCHEMISTRY (3) *Professor Jensen*

AGRICULTURAL ECONOMICS

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.

Head of the Department of Agricultural Economics and Rural Sociology

500. SEMINAR IN AGRICULTURAL ECONOMICS (1-6) Review of current literature and problems.

503. RESEARCH METHODS IN FARM MANAGEMENT (1-3) Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Agr.Ec. 6, Econ. 14.

AGRICULTURAL ECONOMICS

504. AGRICULTURAL PRICE AND INCOME POLICY (3) Analysis of farm prices, income consequences for producers and consumers, and effects on resource use; evaluation of policy, considerations in policy making. Prerequisites: Agr.Ec. 420, Econ. 405. *Professor Brandow*
505. ADVANCED AGRICULTURAL STATISTICS (3) Multiple correlation, curve fitting, analysis of variance, selection of samples, and other techniques applicable to the rural social sciences. Prerequisite: 3 credits in statistics. *Professor Brandow*
506. ECONOMIC PROBLEMS IN MARKETING SPECIFIC AGRICULTURAL PRODUCTS (1-4)
507. SEMINAR IN FARM MANAGEMENT (1-6) Special problems relating to organization and operation of the farm business. Prerequisites: Agr.Ec. 6, Econ. 14.
508. CURRENT LITERATURE SEMINAR IN ECONOMICS OF AGRICULTURAL MARKETING (1-3)
510. ADVANCED FARM FINANCE (1-3) Problems and policies in agricultural credit, insurance, and farm financial management.
515. ECONOMIC PROBLEMS IN THE MARKETING OF DAIRY PRODUCTS (3) Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing. *Professor Pierce*
517. PROBLEMS AND POLICIES OF FARMER CO-OPERATIVES (3) Specific types of co-operative organizations, their problems, policies, and progress; relationships existing among co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Agr.Ec. 17. *Professor Becker*
522. ADVANCED FARM APPRAISAL (3) Land value theory; methods of land valuation; field practice in farm appraisal.
525. RESEARCH METHODS IN RURAL SOCIAL SCIENCES (2) Scientific method in planning and conducting research. Prerequisite: 9 credits in social sciences. *Professor John*
526. RESEARCH METHODS IN AGRICULTURAL ECONOMICS (2) Application of economic and statistical principles. *Professor Baker*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 400, 400X. PUBLIC POLICIES IN AGRICULTURE (1-2)
407. ADVANCED FARM MANAGEMENT (3)
420. AGRICULTURAL PRICES (3) *Professor Brandow*
421. LAND ECONOMICS (3) *Professor Frey*
426. (A.H. 426). LIVESTOCK MARKETING (3) *Professor Trotter*
440. ECONOMICS OF AGRICULTURAL PRODUCTION (3)

AGRICULTURAL EDUCATION

PROFESSOR HENRY S. BRUNNER, M.S., Ph.D.

Head of the Department

- 501v. HISTORY OF AGRICULTURAL EDUCATION (1-3) Development of training for agricultural vocations; emphasis upon introduction of agricultural instruction into the high school program. *Professor Hall*
- 502v, 502vX. TEACHING VOCATIONAL AGRICULTURE (1-3) Organization of instruction with respect to vocational objectives, methods of presentation, supervision of practice, pupil evaluation of goals, and follow-up. *Professor Stevens*
- 503v, 503vX. RESEARCH IN AGRICULTURAL EDUCATION (1-6 per semester) Individual study problems in various phases of agricultural education, such as evaluation of teaching, teaching procedures, and teacher preparation. *Professor Brunner and Staff*
- 504v. AGRICULTURAL EDUCATION SEMINAR (1 per semester) *Professor Brunner and Staff*
- 506v, 506vX. PROBLEMS IN COUNTY VOCATIONAL SUPERVISION (1-3) Needs of county supervisors and vocational directors; co-operation with county superintendents, supervisory duties, plans of work, community meetings and organizations.
- 508v. STATE AND COUNTY ADMINISTRATION AND SUPERVISION OF AGRICULTURAL EDUCATION (1-3) Organization and administration of state, county, township, and district systems of agricultural education; state and federal legislation.
- 509v, 509vX. TEACHER TRAINING IN AGRICULTURAL EDUCATION (1-6) Construction of college curriculums, courses of study, and organization of college departments for training agricultural teachers. *Professor Brunner*
- 520v, 520vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Methods of procedure in investigation and experimentation in education, accompanied by a critical examination of studies made in agricultural education. *Professor Stevens*
- 521v, 521vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Continuation of Agr.Ed. 520v; emphasis upon statistical techniques for students' individual problems. *Professor Stevens*
- 522v, 522vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) Organization and administration of agricultural education in its local bearings; field laboratory surveys of local school conditions. *Professor Brunner and Staff*
- 523v, 523vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) *Professor Brunner and Staff*

AGRICULTURAL EDUCATION

- 524v, 524vX. ANNUAL PLAN OF WORK (1-3) Detailed study of the agricultural education needs of each student's community and outlining annual plans of work. *Professor Brunner*
- 530v. AGRICULTURAL COLLEGE TEACHING (3) Selection and organization of subject matter for specific courses, methods of learning, teaching devices, technique of teaching, and measurements of results of teaching. *Professor Brunner*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 416v. RURAL EDUCATION (3) *Professor Hall*
- 417v, 417vX. RURAL EDUCATION SURVEY (2) *Professor Brunner*
- 418v, 418vX. SURVEY OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Professor Brunner*
- 420v, 420vX. ADVANCED VISUAL AND OTHER SENSORY AIDS IN TEACHING AGRICULTURE (1-6)
- 422v, 422vX. SUPERVISION OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3)
- 434v, 434vX. AGRICULTURAL DEVELOPMENTS (1-6) *Professor Brunner*

AGRICULTURAL ENGINEERING

PROFESSOR FRANK W. PEIKERT, M.S.

Head of the Department

500. ADVANCED ELECTRO-AGRICULTURE (1-6) Investigations in the application of electrical energy to processing, storing, and handling agricultural products. Seminar, written reports.
501. ADVANCED FARM MACHINERY (1-6) Application of agricultural engineering principles to design and operation of farm machinery. Prerequisite: Agr.E. 10.
508. ADVANCED PROBLEMS IN FARM MECHANICS (1-15) Problems in farm shop practice and agricultural engineering related to the farm mechanics program of vocational education in agriculture. Prerequisites: Agr.E. 8, 14; or teaching experience in farm mechanics.
509. RESEARCH IN AGRICULTURAL ENGINEERING (1-4)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. AGRICULTURAL ENGINEERING PROBLEMS AND SEMINAR (1-7)

AGRICULTURAL ENGINEERING

401S. FARM MECHANICS FOR TEACHERS OF VOCATIONAL AGRICULTURE (1½-9)

- Unit A. Farm Utilities (1½)*
- Unit B. Farm Mechanics (1½)*
- Unit C. Farm Engines (1½)*
- Unit D. Farm Machinery (1½)*
- Unit E. Farm Buildings (1½)*
- Unit F. Soil and Water Structures (1½)*

402. FUNCTIONAL DESIGN OF FARM STRUCTURES (3)

405. ADVANCED FARM ELECTRIFICATION (3)

406. ADVANCED DAIRY ENGINEERING (3)

AGRICULTURE—GENERAL

Consult ASSOCIATE DEAN RUSSELL B. DICKERSON, M.S., Ph.D.

The following course may be taken for graduate credit under the restrictions in force:

400. INTRODUCTORY BIOMETRY (3)

AGRONOMY

PROFESSOR HOWARD B. SPRAGUE, M.S., Ph.D.

Head of the Department

501. ADVANCED SOIL FERTILITY (4) Interpretation of fertility experiments and diagnosis of soil-plant relationships through field appraisal, analysis, and plant symptoms. Prerequisites: Agro. 431, Bot. 406. *Professor Merkle*

503. AGRONOMY SEMINAR (1) Weekly meeting where papers and discussions will be presented by students and staff members. Each student will present a paper on some phase of his major subject.

Professor H. B. Sprague

506. SOIL CHEMISTRY (4) Analyses of important chemical and biochemical reactions occurring in soils, conditions which control these reactions and their importance in soil genesis and plant growth; laboratory work in the more typical and significant analytical procedures; lectures, review of current literature, and practicum. Prerequisites: Agro. 419; A.B.Ch. 417 or Chem. 20.

Professor Satchell

507. SOIL PHYSICS (4) Physical properties of the soil; factors affecting them; their measurements, evaluation, and influence in determination of soil productivity. Prerequisites: Agro. 419, Phys. 215, A.B.Ch. 425.

509. GENETICS OF CROP PLANTS (3) Inheritance in crop plants with particular reference to factor interaction, genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 422.

Professor Cleveland

AGRONOMY

510. THE APPLICATION OF CYTOGENETICS TO PLANT BREEDING (3) Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 422. *Professor Cleveland*
511. THE BREEDING OF FARM CROPS (3) Application of genetic principles to improvement of crop plants. Prerequisite: Bot. 22. *Professor Cleveland*
512. FIELD PLOT TECHNIQUE (4) Ramifications of analysis of variance technics; combining and analyzing data from several experiments; selection of valid error terms. Prerequisite: Math. 8 or Agr. 400. *Professor Fortmann*
516. HUMUS (2) Origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 419, 431.
517. FARM CROPS ECOLOGY (2) Ecological factors influencing distribution and production of field crops. Prerequisites: Math. 8, Bot. 406. *Professor Huber*
518. GROWTH AND MANAGEMENT OF FORAGE CROPS (3) Factors affecting growth and development of forage crops with particular reference to effects of environment, defoliation, and management practices. Prerequisites: Agro. 423, Bot. 406. *Professor V. G. Sprague*
519. THE NATURE OF SOIL MINERALS (3) Modern methods for identification of the constituent minerals of soils and their relation to soil classification and agricultural practices. Prerequisites: Agro. 1, Chem. 2, Geol. 31. *Professor Jeffries*
520. SPECIAL SOILS PROBLEMS (1-6 per semester) Provides basic or practical training in the soils sciences by means of library, field, and laboratory assignments.
545. THE APPLICATION OF STATISTICS TO FIELD EXPERIMENTS (4) Use of advanced experimental designs in planning, analyzing, and interpreting experiments; includes lattice designs, factorials, confounding, simple and multiple covariance techniques. Prerequisite: Agro. 512. *Professor Fortmann*
550. SPECIAL CROPS PROBLEMS (1-6 per semester) Provides basic or practical training in the crops sciences by means of library, field, and laboratory assignments.
582. SEMINAR IN THE BREEDING AND GENETICS OF FARM CROPS (1-8 per semester)
- 583S. LABORATORY METHODS IN FIELD CROPS (3) Prerequisite: Agro. 512.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

416. SOIL CLASSIFICATION (5) *Professor Higbee*

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| 419. | SOIL PROPERTIES (5) | <i>Professor Merkle</i> |
| 422. | SOIL CONSERVATION (3) | |
| 423. | PASTURE AND GRASSLAND MANAGEMENT (3) | <i>Professor Washko</i> |
| 429. | (Bot. 429). WHITE POTATO PRODUCTION (3) | <i>Professors Cobb and Mills</i> |
| 431. | SOIL FERTILITY AND MANAGEMENT (3) | <i>Professor Merkle</i> |
| 490. | AGRONOMIC PRACTICES (1-6) | |

ANIMAL HUSBANDRY

PROFESSOR WILLIAM L. HENNING, M.S., Ph.D.

Head of the Department

501. PEDIGREE STUDY (1-6) Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book. *Professor Henning*
502. RESEARCH IN MEATS (1-6 per semester) Investigation of methods for handling, cutting, processing, freezing, and curing meat and meat products. Prerequisite: A.H. 421. *Professor Ziegler*
503. LIVESTOCK MANAGEMENT (3) Handling of purebred herds and flocks; relation of livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding.
505. ADVANCED ANIMAL BREEDING (1-5) Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22. *Professor Henning*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 421. | ADVANCED MEAT STUDIES (3) | <i>Professor Ziegler</i> |
| 423. | ADVANCED STOCK JUDGING (2) | <i>Professor Henning</i> |
| 424. | ANIMAL HUSBANDRY SEMINAR (1) | |
| 426. | (Agr.Ec. 426). LIVESTOCK MARKETING (3) | |
| 431. | ADVANCED MEAT JUDGING (2) | |

ANIMAL NUTRITION

PROFESSOR RAYMOND W. SWIFT, M.S., Ph.D.

Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

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| 401. | PHYSIOLOGY OF NUTRITION (3) | <i>Professor Barron</i> |
| 402. | PHYSIOLOGY OF NUTRITION (3) | <i>Professor French</i> |

ANTHROPOLOGY

ANTHROPOLOGY

PROFESSOR ROBERT E. CLARK, M.A., Ph.D.

Acting Head of the Department of Sociology

540. THEORY AND METHOD IN ANTHROPOLOGY (3) Theory and method used in culture-historical, sociological, and psychological interpretations.

Professor Mook

545. SEMINAR IN ANTHROPOLOGY (1-9) Critical analysis of research in selected areas of regional ethnography and ethnological theory. Prerequisites: Anthy. 45, 445.

Professor Mook

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

441. FOLK SOCIETY (3)

Professor Mook

443. ANTHROPOLOGY OF THE OLD WORLD (3)

Professor Mook

445. PRIMITIVE SOCIETY (3)

Professor Mook

ARCHAEOLOGY

PROFESSOR ROBERT E. CLARK, M.A., Ph.D.

Acting Head of the Department of Sociology

The following courses may be taken for graduate credit under the restrictions in force:

- 400-401. ARCHAEOLOGY OF THE NEAR EAST (3 each)

Professor Matson

- 402-403. ARCHAEOLOGY OF THE NEW WORLD (3 each)

Professor Matson

ARCHITECTURAL ENGINEERING

Consult PROFESSOR LOUIS A. RICHARDSON, M.S., P.E.

502. ARCHITECTURAL ENGINEERING (3-8) Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar.

Professor Richardson and Staff

503. ARCHITECTURAL ENGINEERING (4-8) Continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed constructions are studied. Practicum and seminar.

Professor Fox

504. ARCHITECTURAL ENGINEERING (4-8) Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar.

Professor Richardson and Staff

ARCHITECTURAL ENGINEERING

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401. ARCHITECTURAL ENGINEERING (3)
- 402. ARCHITECTURAL ENGINEERING (4)
- 403. ARCHITECTURAL ENGINEERING (3)
- 420. ARCHITECTURAL ENGINEERING (3)
- 421. ARCHITECTURAL ENGINEERING (4)
- 422. ARCHITECTURAL ENGINEERING (3)
- 423. ARCHITECTURAL ENGINEERING THESIS (2)
- 424. ARCHITECTURAL ENGINEERING THESIS (5)

ARCHITECTURE

PROFESSOR MILTON S. OSBORNE, M.S., R.A.

Head of the Department

- 501. ARCHITECTURAL DESIGN (4-8) Problems in advanced planning and design, including study of group composition. Practicum and seminar.
Professor Osborne and Staff
- 502. ARCHITECTURAL RESEARCH (2-12) Prosecution of assigned problems under the guidance of an instructor.
Professor Osborne and Staff
- 503. ARCHITECTURAL HISTORY RESEARCH (3-12) Original research in architectural history. Seminar and written reports. *Professor Dickson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 410. ADVANCED ARCHITECTURAL DESIGN (2-12)
Professor Osborne and Staff
- 411. ADVANCED ARCHITECTURAL DESIGN (8)
- 412. ADVANCED ARCHITECTURAL DESIGN AND THESIS (8)
- 421. CONTEMPORARY ARCHITECTURE (3)
Professor Norton

ART

Consult PROFESSOR ANDREW W. CASE, M.A.

(See also courses in Art Education below.)

- 500. ART RESEARCH (2-6) Prosecution of assigned problems under the guidance of an instructor.
Professor Galbraith
- 501. ITALIAN PAINTING (2-6) Investigations of early Italian painting. Seminar, written reports.
Professor Dickson
- 502. MEDIEVAL SCULPTURE (2-6) Sculpture of Italy and France from the 9th to the 13th centuries. Seminar, written reports.
Professor Norton

503. ART HISTORY RESEARCH (3-12) Original investigation in art history, to be pursued independently or concurrently with course work in particular fields. Prerequisite: 6 credits in history of art. *Professor Dickson and Staff*

504. SEMINAR: ART LITERATURE AND ICONOGRAPHY (2-6) Methods of research in the fine arts; survey of the literature of art; studies in iconography. Prerequisite: 6 credits in history of art. *Professor Dickson and Staff*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. OIL PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-12)

403S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3)

Professor Dickson

404S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3)

Professor Dickson

410. WATER-COLOR PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9)

Professor Case

420. APPLIED DESIGN (3-9)

442S. ART OF THE MIDDLE AGES AND RENAISSANCE IN ITALY (3)

443S. ART IN AMERICA (3)

444S. ART IN NORTHERN EUROPE (3)

490. LIFE DRAWING (3)

Professor Case

ART EDUCATION

Consult PROFESSOR VIKTOR LOWENFELD

514. FUNCTIONAL RELATIONSHIPS IN CRAFTS (3) Relationships of material design and purpose in crafts discussed by means of outstanding products of different materials, periods, and cultures. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts. *Professor Emerson*

534. CREATIVE ART ACTIVITY FOR THE HANDICAPPED (3) Specific methods for development of creative art activity with the physically, mentally, emotionally, and socially handicapped; adjustive effect upon them. Prerequisite: 6 credits in art education or 6 in special education or 6 in psychology. *Professor Lowenfeld*

586. RESEARCH IN ART EDUCATION (3-9) Current experiments in art education; required of students working for a master's degree in art education. *Professor Beittel*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

402. METHODS OF TEACHING DRAWING IN THE GRADES (2-3)

Professor Mattil

404. METHODS OF GRAPHICS AND ILLUSTRATIONS (3)

Professor Emerson

414, 414X. ADVANCED CRAFTS FOR TEACHERS (3-6)

Professor Beittel

- 434, 434X. ART APPRECIATION IN THE EDUCATIONAL PROGRAM (3) *Professor Beittel*
 434b, 434bX. ART IN THE ELEMENTARY SCHOOL (2-3) *Professor Lowenfeld*
 434c, 434cX. ART IN THE SECONDARY SCHOOL (3) *Professor Mattil*
 434d. ART SUPERVISION (3) *Professor Mattil*
 486, 486X. CURRENT PROBLEMS IN ART EDUCATION (2-3) *Professor Mattil*
 487. MURAL PAINTING IN SCHOOLS (3) *Professor Lowenfeld*
 488. ADVANCED MURAL PAINTING IN SCHOOLS (3) *Professor Lowenfeld*

ASTRONOMY

PROFESSOR JOHN A. SAUER, M.S., Ph.D.

Head of the Department of Physics

The following courses may be taken for graduate credit under the restrictions in force:

430. GENERAL ASTRONOMY FOR TEACHERS (3)
 486. ASTRONOMICAL PHOTOGRAPHY (3)
 490-491. INTRODUCTION TO ASTROPHYSICS (3 each)

BACTERIOLOGY

PROFESSOR ROBERT W. STONE, Ph.D.

Head of the Department

506. RESEARCH (1-15 per semester) Special problems in microbiology.
 507. SEMINAR (1 per semester) Reports on current fields of research.
 508. PHYSIOLOGY OF BACTERIA (2) Composition, nutrition, and growth of microorganisms; influence of physical and chemical environment on metabolism.
 508a. LABORATORY IN PHYSIOLOGY OF BACTERIA (2) Laboratory work to accompany the lectures given in Bact. 508.
 509. FERMENTATION (2) Chemical activities of microorganisms; mechanisms of fermentative and oxidative metabolism.
 510. LABORATORY IN FERMENTATION (2) Laboratory procedures and problems in fermentation to accompany Bact. 509.
 512. BACTERIOLOGICAL TECHNIQUES (1-6) Practice in special laboratory techniques including manometry, tissue culture, and serology.
 515. VIROLOGY (2-4) Rickettsial and viral agents parasitizing man, animals, and microorganisms. Prerequisite: Bact. 410.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

BACTERIOLOGY

- 401. GENERAL MICROBIOLOGY (4)
- 407. BACTERIOLOGY PROBLEMS (2-9)
- 410. IMMUNOLOGY AND SEROLOGY (4)
- 411. BACTERIOLOGICAL SURVEY (1)
- 412. ADVANCED BACTERIOLOGY (4)
- 413. SOIL MICROBIOLOGY (3)
- 414. FOOD MICROBIOLOGY (4)
- 416. INDUSTRIAL MICROBIOLOGY (4)

BOTANY

PROFESSOR HENRY W. POPP, M.S., Ph.D.

Head of the Department of Botany and Plant Pathology

- 500. PLANT PHYSIOLOGY SEMINAR (1 per semester) Selected topics from recent literature; staff and student reports on current research.
Professors Popp and Van Norman
- 501. THE PHYSIOLOGY OF THE FUNGI (3) Chemical composition, metabolism, toxic and stimulating agencies, spore germination, growth and irritability of the fungi. Prerequisites: Bot. 406, 419, and preferably Chem. 32.
Professor Fergus
- 505. CYTOLOGY AND CYTOGENETICS (3) Cells and their components; nuclear and cell division, meiosis and fertilization; the chromosome mechanism of heredity. Prerequisites: Bot. 22, 421.
Professor Hawthorne
- 506. COMPARATIVE ANATOMY OF VASCULAR PLANTS (3) Structure of the Tracheophyta from a phylogenetic standpoint. Prerequisite: Bot. 407.
Professor Kribs
- 508. PROBLEMS IN GENETICS (2-6) Problems to suit needs of individual students; conferences and laboratory work. Prerequisite: Bot. 422.
Professor Wright
- 509. PHYSIOLOGY OF PATHOGENICITY (3) Physiological processes of plant pathogenic bacteria and fungi occurring during incubation, ingress, and infection. Prerequisite: Bot. 10, 11, or 419.
- 511. PHYSIOLOGY OF PLANT GROWTH AND DEVELOPMENT (2-4) Prerequisite: Bot. 406.
Professor Popp
- 512. PHYSIOLOGY OF PLANT METABOLISM (2-4) Prerequisite: Bot. 406.
Professor Van Norman
- 513. WATER AND MINERAL RELATIONS OF PLANTS (2-4) Absorption of water and minerals; transport of materials within the plant; physiology of transpiration. Prerequisite: Bot. 406.
Professor Van Norman
- 515. DISEASE RESISTANCE IN PLANTS (2-4) Stability of resistance, selection of resistant material, economics of control, special problems. Prerequisites: Bot. 22 or 32, 10.
Professors Wernham and Mills

518. BOTANICAL PROBLEMS (1-15 per semester) *Professor Popp and Staff*
519. PLANT VIRUSES (3) Nature, symptomatology, transmission, and control of virus diseases of plants. *Professor Boyle*
520. PLANT PATHOGENIC BACTERIA (3) Bacteria causing plant diseases, methods of identification, inoculation and control. *Professor Kneebone*
521. MOLDS, YEASTS, AND ACTINOMYCETES (3) Morphology and taxonomy of fungi important in microbiology; identification and techniques of study.
522. MYXOMYCETES, PHYCOMYCETES, AND ASCOMYCETES (4) Morphology, taxonomy, phylogeny, and life histories; identification and field work. Prerequisite: Bot. 419. *Professor Fergus*
523. BASIDIOMYCETES AND FUNGI IMPERFECTI (4) Morphology, taxonomy, phylogeny, and life histories. Prerequisite: Bot. 419. *Professor Fergus*
524. SEMINAR IN GENETICS (1 per semester) Review of current research publications in genetics. *Professor Wright*
526. PHOTOMICROGRAPHY OF PLANT TISSUES (2) Prerequisite: Bot. 421 or Zool. 31 or For. 37. *Professor Kribs*
- 527aS-527bS. PLANT BIOLOGY (3 each) (a) Structure and physiology; (b) reproduction processes, development and relationships of plant groups. Methods of obtaining materials and setting up experiments. Given in alternate years. Prerequisite: general biology or general botany courses.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

405. PLANT MORPHOLOGY AND CYTOLOGY (4)
406. PLANT PHYSIOLOGY (4) *Professor Van Norman*
407. PLANT ANATOMY (3) *Professor Kribs*
408. PLANT PATHOLOGICAL TECHNIQUES (3)
409. PLANT ECOLOGY (3) *Professor Kovar*
412. ADVANCED FOREST PATHOLOGY (3) *Professor Fergus*
- 414, 414X. TAXONOMY OF VASCULAR PLANTS (3) *Professor Wahl*
415. MORPHOLOGY OF THE ALGAE (3) *Professor Wahl*
416. MORPHOLOGY OF THE BRYOPHYTES (2) *Professor Grove*
417. MORPHOLOGY OF THE TRACHEOPHYTES EXCLUSIVE OF ANGIOSPERMS (3) *Professor Grove*
418. BOTANICAL PROBLEMS (1-6) *Professor Popp and Staff*
419. MYCOLOGY (3) *Professor Fergus*
420. MORPHOLOGY OF THE ANGIOSPERMS (3) *Professor Grove*
421. BOTANICAL TECHNIQUE (3) *Professor Grove*
422. ADVANCED GENETICS (3) *Professor Wright*
424. COMMERCIAL TROPICAL WOODS (3) *Professor Kribs*
- 425a, 425b. STRUCTURE OF ECONOMIC PLANTS (3-6) *Professor Grove*
427. ADVANCED SYSTEMATIC BOTANY (1-6) *Professor Wahl*
428. ADVANCED PLANT PATHOLOGY (2)
429. (Agro. 429). WHITE POTATO PRODUCTION (3) *Professor Mills*
- 432S. GENETICS, EUGENICS, AND EVOLUTION (3) *Professor Wright*

BUSINESS STATISTICS

Consult PROFESSOR ROGER B. SAYLOR, A.M., Ph.D.

500. SEMINAR IN BUSINESS STATISTICS (3)
501. ADVANCED BUSINESS STATISTICS (3)

Professor Saylor
Professor Saylor

CERAMICS

PROFESSOR FLOYD A. HUMMEL, M.S.

Acting Head of the Department

500. CERAMIC SEMINAR (1 per semester) Conferences, reading, and reports. Required of all graduate students in ceramics. Prerequisites: Chem. 461, Phys. 285.
502. HEAT TREATMENT OF CERAMIC MATERIALS (2-5) Effect of controlled heat treatment on physical and chemical properties of various mineral systems.
503. CONSTITUTION OF GLASS (2-4) Advanced course on glass dealing with latest developments in the structure of viscous liquids and transparent amorphous solids. Prerequisite: Cer. 415. *Professor Weyl*
504. RESEARCH INSTRUMENTS AND EQUIPMENT (2) Applications of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations). Prerequisite: Cer. 411.
506. GLASS TECHNOLOGY SEMINAR (1-6) Group discussion of special advanced topics concerning properties and manufacture of glass. Prerequisite: Cer. 415. *Professor Weyl and Staff*
507. COLORING AND DECOLORING GLASS (1) Physical-chemical considerations of various coloring oxides; oxidation-reduction equilibria pertaining to coloring and decolorizing of glass. Prerequisite: Cer. 415. *Professor Weyl*
508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Colloidal activity in bodies, glazes, and enamels, drilling fluids, filtering and bleaching clays, and similar mineral systems. (In co-operation with the Petroleum and Natural Gas staff.) Prerequisite: Chem. 461. *Professor Henry*
509. SILICATE SYSTEMS (3) Properties of silica; classification of silicates; reactions in binary and ternary systems; industrial applications of the phase rule. Prerequisites: Chem. 461, Cer. 303.
510. CERAMIC PROBLEMS (1-6 per semester) Advanced individual study on a problem in some branch of ceramics, including review of the literature and a full report. Prerequisite: Cer. 411.

511. SELECTED TOPICS IN CERAMICS (1-3 per semester) Intensive group study of special subjects, such as diffusion in solids, viscosity, and kinetics of ceramic processes. Prerequisite: Chem. 461, Phys. 285.
512. SYNTHESIS OF CERAMIC COMPOUNDS (3) Advanced ceramic technology applied to the control of phases formed in commercial production of glass, whitewares, refractories, and cements. Prerequisites: Chem. 461, Cer. 303. *Professor Hummel*
514. MECHANICAL AND THERMAL PROPERTIES OF CERAMIC MATERIALS (3) Definition, measurement, and control of the mechanical and thermal properties of ceramic materials. *Professor Buessem*
515. ELECTRIC AND MAGNETIC PROPERTIES OF CERAMIC MATERIALS (3) *Professor Buessem*

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in ceramic studies are listed under Mineral Sciences.*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. SPECIAL TOPICS (1-2)
401. CERAMIC BODIES AND GLAZES (3) *Professor Hummel*
402. PRINCIPLES OF CERAMIC ENGINEERING (3) *Professor Henry*
403. CERAMIC ENGINEERING PROCESSES AND EQUIPMENT (3)
404. CERAMIC SEMINAR (1)
405. CERAMIC RESEARCH AND DESIGN (3)
411. THEORY OF CERAMIC PROCESSES (2) *Professor Hummel*
- 413, 413X. CERAMIC PETROGRAPHY (3)
415. GLASS AND ENAMELS (3) *Professor Ehman*
416. ADVANCED GLASS TECHNOLOGY (3) *Professors Weyl and Rindone*
420. REFRACTORIES (3)

CHEMICAL ENGINEERING

PROFESSOR DONALD S. CRYDER, M.S., D.Sc.

Head of the Department

500. SEMINAR IN CHEMICAL ENGINEERING (1) Required of all graduate students.
510. ADVANCED HEAT TRANSFER I (3) Physical and chemical factors controlling the rate of heat transfer under conditions of steady flow. *Professor Cryder*
511. ADVANCED HEAT TRANSFER II (3) Flow of heat under varying temperature conditions. *Professor Cryder*
515. DISTILLATION (3) Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns. *Professor Carnahan*

CHEMICAL ENGINEERING

516. ECONOMIC BALANCE (3) Problem work on the design of chemical engineering equipment from the economic standpoint. *Professor Cannon*
518. CHEMICAL ENGINEERING DESIGN (3) Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. *Professor Cryder*
524. CHEMICAL ENGINEERING, APPLICATION OF THERMODYNAMICS (3) Elements of thermochemistry and thermodynamics of greatest importance in chemical engineering. *Professor Cannon*
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
402. CHEMICAL ENGINEERING (4) *Professor Carnahan*
403. CHEMICAL ENGINEERING (4) *Professor Carnahan*
422. MOTOR FUELS (2) *Professor Carnahan*

CHEMISTRY

PROFESSOR W. CONARD FERNELIUS, M.A., Ph.D.

Head of the Department

500. SEMINAR IN INORGANIC CHEMISTRY (1)
501. SEMINAR IN PHYSICAL CHEMISTRY (1)
502. SEMINAR IN ORGANIC CHEMISTRY (1)
503. SEMINAR IN ANALYTICAL CHEMISTRY (1)
516. SYSTEMATIC INORGANIC CHEMISTRY (3) Systematic treatment of inorganic chemistry in terms of modern concepts. *Professors Fernelius, Wartik, and Haas*
517. CHEMISTRY OF THE LESS FAMILIAR ELEMENTS (3) Continuation of Chem. 516. *Professors Fernelius, Wartik, and Block*
518. SPECIAL TOPICS IN INORGANIC CHEMISTRY (3 per semester) Modern developments in specialized fields.
525. ANALYTICAL CHEMISTRY (3) Analytical principles as applied to analysis of inorganic and organic substances. *Professor Hayes*
526. ADVANCED ANALYTICAL CHEMISTRY (3) Theory and practice of contemporary analytical chemistry as used in chemical research and plant operation.
527. SPECIAL TOPICS IN ANALYTICAL CHEMISTRY (2-12) Currently used techniques in analytical chemistry.
531. SPECIAL TOPICS IN ORGANIC CHEMISTRY (3) May be taken for credit for four successive semesters.

532. ORGANIC NITROGEN COMPOUNDS (3) Chemistry, stereochemistry, and molecular structure of organic compounds containing nitrogen.
Professor Aston
534. THEORETICAL ORGANIC CHEMISTRY (3) Modern theories of structure; resonance; interpretation of physical properties; theory of rates; equilibrium properties.
Professor Aston
- 535-536. ORGANIC CHEMISTRY (3 each) Adapted to the needs of those doing research work in organic chemistry.
Professor Zook
538. ORGANIC CHEMISTRY (3) Survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry.
Professors Noll and Oakwood
539. STEREOCHEMISTRY (3) Comprehensive treatment of the principles of stereochemistry as applied to organic compounds.
Professor Oakwood
541. PHASE RULE (3) The phase rule and its applications.
Professor Currier
542. COLLOIDS (3) The physics and chemistry of surfaces and their resulting colloid properties. Methods of preparing colloids.
Professor Smith
543. RHEOLOGY OF COLLOIDS (3) Continuation of Chem. 542. Rheology especially as applied to colloids and similar substances.
Professor Smith
544. CHEMICAL THERMODYNAMICS (3) Development of thermodynamic theory with special reference to common physical changes and chemical reactions. Prerequisite: Chem. 441 or 562.
Professors Aston and Fritz
545. CHEMICAL THERMODYNAMICS AND INTRODUCTORY STATISTICAL MECHANICS (3) Continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544.
Professors Aston and Fritz
546. QUANTUM CHEMISTRY (3) Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with special emphasis on the portion of the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Given alternate years only.
Professor Aston
547. STATISTICAL MECHANICS (3) Properties of matter at equilibrium, developed on the basis of energy levels of molecules and statistical mechanical theory. Prerequisite: Chem. 546. Given alternate years only.
Professor Aston
548. CATALYSIS (3) Theory of catalysis and its application to industry.
Professor Currier
- 561-562. CHEMICAL PRINCIPLES (3 each) Mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 461, Math. 11, Phys. 285. A course in organic chemistry is recommended.
Professors Seward, Fritz, Ascah, and Taft

CHEMISTRY

563. CHEMICAL KINETICS (3) Theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions.

Professors Ascah and Taft

564. CHEMICAL KINETICS (3) Continuation of Chem. 563 but including theory and measurement of photochemical reactions.

Professors Ascah and Taft

- 565-566. ATOMIC AND MOLECULAR STRUCTURE (3 each) Structure of chemical species and correlation of experimentally determined properties by structural theory.

- 567-568. ADVANCED THEORETICAL CHEMISTRY (3 each) Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. CHEMICAL LITERATURE (1) *Miss Jackson*

- 411-412. FLUORINE CHEMISTRY (3 each)

413. INORGANIC PREPARATIONS AND LABORATORY METHODS (2-5) Breakage ticket \$5. *Professor Block*

426. ADVANCED QUALITATIVE AND QUANTITATIVE ANALYSIS (3-5) Breakage ticket \$10. *Professor Hayes*

434. QUANTITATIVE ORGANIC ANALYSIS (3-5) Breakage ticket \$10.

435. ORGANIC PREPARATIONS AND LABORATORY METHODS (3-5) Breakage ticket \$10. *Professor Oakwood*

436. ORGANIC CHEMISTRY OF NATURAL PRODUCTS (3) *Professor Aston*

437. QUALITATIVE ORGANIC ANALYSIS (3) Breakage ticket \$5.

Professors Olewine and Noll

- 440-441. ADVANCED PHYSICAL CHEMISTRY (3 each)

Professors Hutchison and Seward

448. COLLOID CHEMISTRY (3) Breakage ticket \$5. *Professor Hutchison*

- *460-461. INTRODUCTORY PHYSICAL CHEMISTRY (3 each)

- *462. EXPERIMENTAL PHYSICAL CHEMISTRY (1) Breakage ticket \$5.

- *463. EXPERIMENTAL PHYSICAL CHEMISTRY (1) Breakage ticket \$5.

- *464. PHYSICAL CHEMISTRY (3)

- *465. PHYSICAL CHEMISTRY (2)

470. CHEMICAL MICROSCOPY (3) Breakage ticket \$5. *Professor Willard*

471. ADVANCED CHEMICAL MICROSCOPY (3) Breakage ticket \$5.

Professor Willard

472. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$5.

Professor Fleming

473. TEXTILE MICROSCOPY (3) Breakage ticket \$5. *Professor Willard*

474. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$5.

Professor Fleming

475. INTRODUCTION TO CHEMICAL SPECTROSCOPY (3) Breakage ticket \$5.

Professor Schempff

476. MICROSCOPIC MICROTÉCHNIQUE (3) Breakage ticket \$5.

Professor Willard

*Graduate credit not allowed for students majoring in chemistry or chemical engineering.

477. CHEMICAL PHOTOMICROGRAPHY (3) Breakage ticket \$5. *Professor Willard*
 489. INTRODUCTION TO CHEMICAL RESEARCH (3-5) Breakage ticket \$10.
 489X. INTRODUCTION TO CHEMICAL RESEARCH (2)
 †490. ORGANIC CHEMISTRY (5) Breakage ticket \$5. *Professor Olewine*
 †491. ORGANIC CHEMISTRY (5) Breakage ticket \$10. *Professor Olewine*
 †492a. ADVANCED GENERAL CHEMISTRY (3) *Professor Currier*

CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS

PROFESSOR WINONA L. MORGAN, M.A., Ph.D.

Head of the Department

508. PARENTAL EDUCATION (3) Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: Ch.Fm. 429, 430. *Professor Morgan*
- 515, 515X. THE TEACHING OF CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (3) Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for Ch.Fm. 482. Prerequisite: 6 credits in child development and family relationships. *Professor Morgan*
529. (Psy. 529). SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisites: Ch.Fm. 429, 430, or Psy. 411, or 425. *Professor Morgan*
536. CHILDREN IN POSTWAR FAMILIES AND COMMUNITIES (3) Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: Ch.Fm. 429, 430, or 2 courses in psychology. *Professor Morgan*
- 545, 545X. THE FAMILY IN ITS COMMUNITY (2-3) Cultural influences on family relationships; how the family orients its members to community living and group participation. Prerequisites: Soc. 1, Ch.Fm. 405; R.Soc. 452 or Psy. 419. *Professor Smith*
546. SEMINAR IN FAMILY RELATIONSHIPS (1-3) Reading, reports, and discussion of recent research in relationship aspects of family living; particular attention to studies of roles, crises, and adjustments within the family setting. Prerequisite: Ch.Fm. 405 or 6 hours of sociology or psychology. *Professor Smith*

†Candidates for the M.Ed. degree.

CHILD DEVELOPMENT

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

405. MARRIAGE AND FAMILY RELATIONSHIPS (3) *Professor Smith*
429, 429X. CHILD DEVELOPMENT (3) *Professor Avery*
430. OBSERVATION AND EXPERIENCE IN NURSERY SCHOOL (1-4)
440, 440X. STUDY OF LATER CHILDHOOD (3) *Professor Avery*
441. NURSERY SCHOOL ORGANIZATION (3) *Professor Morgan*
445. (Psy. 445). DEVELOPMENT THROUGHOUT ADULTHOOD (3) *Professor Britton*
481. EDUCATIONAL METHODS WITH PRESCHOOL CHILDREN (3) *Professor Bovie*
482. EDUCATIONAL PROCEDURES IN CHILD DEVELOPMENT AND FAMILY RELATIONS (3) *Professor Morgan*
495S. (Ed. 495S, Hl.Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)

CIVIL ENGINEERING

PROFESSOR BENJAMIN A. WHISLER, M.S., Sc.D., P. E.

Head of the Department

500. SEMINAR IN CIVIL ENGINEERING (1-6) Reports on researches and special topics. Course may be continued in subsequent semesters.
521. TRANSPORT PLANNING AND DESIGN (2-6) Planning and design of transportation facilities; basic principles and engineering techniques applied to airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.
522. TRANSPORT OPERATION AND MAINTENANCE (2-6) Engineering problems in operation, maintenance, and administration of airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.
540. ADVANCED STRUCTURAL ANALYSIS (2-4) Geometry of flexure, deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C.E. 40.
541. ADVANCED STRUCTURAL ANALYSIS (2-4) Truss deflection; trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C.E. 40.
542. APPLIED SOIL MECHANICS (2-5) Soil classification by type of clay minerals and profile development; aerial photographic interpretation of soils and applications to site selection for dams, highways, and airports. Prerequisites: C.E. 412, 444, Geol. 71.
543. STRUCTURAL ENGINEERING PROJECTS (3-10) Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C.E. 441, 442.

544. ADVANCED STRUCTURAL DESIGN (2-4) Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisites: C.E. 42, 442.
545. ADVANCED STRUCTURAL DESIGN (2-4) Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C.E. 41.
550. ENGINEERING CONSTRUCTION (2-4) Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C.E. 41, 42.
551. HYDROLOGIC INVESTIGATIONS (2-8) Application of hydrologic principles and techniques to a specific project. Prerequisite: C.E. 451.
560. THEORY OF HYDRAULIC MODELS (3) Application of dimensional analysis and similitude to models used in the study of problems in hydraulics.
565. TRANSPORTATION OF SOLIDS BY FLUIDS (2-5) Fundamentals of the flow of solids in open and closed conduits; e.g., suspended load and bed load in rivers, slurries and pulp stocks in pipes.
566. FLUID MECHANICS OF HYDRAULIC MACHINERY (3) Advanced theory and design of hydraulic machinery. Prerequisite: C.E. 466.
568. THEORETICAL HYDRODYNAMICS (3-6) Fundamental equations of fluid motion, stream function, velocity potential, flow nets, transformations, motion of viscous fluids, applications.
570. RURAL SANITATION DESIGN (3) Requirements and devices essential to rural sanitary problems: water supply, excreta disposal, industrial waste treatment. Not intended for civil or sanitary engineering students. Prerequisites: Chem. 4, Phys. 285.
571. WATER PURIFICATION AND SOFTENING (3) Current methods of softening, disinfecting, and conditioning water for municipal and industrial use. Prerequisite: C.E. 70.
572. SEWAGE TREATMENT (3) Modern methods of sewage treatment. Prerequisite: C.E. 70.
573. ADVANCED PROBLEMS IN SANITARY ENGINEERING (3-10) Continuation of C.E. 474 on a graduate level. Prerequisite: C.E. 474.
575. ADVANCED INDUSTRIAL WASTE TREATMENT (3) Techniques of industrial waste treatment; attendant stream pollution and stream self-purification factors. Prerequisite: C.E. 472 or 572.
576. WATER TREATMENT PLANT DESIGN (1-6) Design of works for treatment of water for municipal and industrial use. Prerequisite: C.E. 71.
577. SEWAGE TREATMENT PLANT DESIGN (1-6) Design of works for treatment of sewage or industrial wastes. Prerequisite: C.E. 71.
578. INDUSTRIAL HYGIENE (3) Principles of control of industrial toxics and the protection of the worker and the community.

CIVIL ENGINEERING

579. PUBLIC HEALTH ADMINISTRATION (3) Operation and duties of health departments at the various levels.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401. CIVIL ENGINEERING PROJECTS (2-12)
- 412. ADVANCED PHOTOGRAMMETRY (3)
- 421. HIGHWAYS AND STREETS (3)
- 422. RAILROADS (3)
- 423. HIGHWAY SAFETY AND TRAFFIC CONTROL (3)
- 431. CIVIL ENGINEERING CONSTRUCTION (3)
- 441. STATICALLY INDETERMINATE STRUCTURES (3)
- 442, 442X. STATICALLY INDETERMINATE STRUCTURES (3)
- 443. PHOTOELASTICITY AND MODEL ANALYSIS (3)
- 444, 444X. SOIL MECHANICS AND FOUNDATIONS (3)
- 446. ADVANCED SOIL MECHANICS (3)
- 451. ADVANCED HYDROLOGY (3)
- 462. ADVANCED HYDRAULICS (3)
- 465. APPLIED HYDRAULICS (3)
- 466. HYDRAULIC MACHINERY (3)
- 471. MUNICIPAL AND RURAL SANITATION (3)
- 472. TREATMENT PLANTS (3)
- 473. WATER AND SEWAGE ANALYSIS (3)
- 474. SANITARY ENGINEERING PROBLEMS (1-6)
- 481. MUNICIPAL PLANNING AND ZONING (3)

CLOTHING AND TEXTILES

PROFESSOR RUTH W. AYRES, A.M., Ph.D.

Head of the Department

- 503. ADVANCED FITTING AND PATTERN STUDY (3) Application of principles involved in altering patterns and fitting garments to give students freedom in designing and ability to deal with difficult fitting problems. Prerequisite: Cl.Text. 201.
- 504. ADVANCED DRESS DESIGN (3) Draping of garments difficult in type and distinctive in design; survey of literature in dress design. Prerequisites: Art 56, Cl.Text. 404.
- 505, 505X. CLOTHING INSTRUCTIONAL MATERIALS (3) Preparation and evaluation of different types of materials for instruction in textiles and clothing. Prerequisite: Cl.Text. 201.
- 506. THE FASHION WORLD (3) Development of fashion throughout the ages; relationship of present-day fashions and practices with previous periods. Prerequisites: Cl.Text. 102, 301.

CLOTHING AND TEXTILES

507. PROBLEMS IN RELATION TO CLOTHING CONSUMPTION (3) Problems connected with manufacture and consumption of clothing, interrelation of textile and clothing trades with other industries. Prerequisite: Cl.Text. 301.
508. SPECIAL PROBLEMS IN CLOTHING AND TEXTILES (1-6) Individual directed study, investigation, and practice in selected phases of textiles and clothing. Prerequisites: Cl.Text. 102, 201.
- 509, 509X. SEMINAR IN CLOTHING AND TEXTILES (1-6) Discussion and reports on current research in clothing and textiles.
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
401. CLOTHING CONSERVATION (2-3)
- 402S, 402X. FUNDAMENTAL PRINCIPLES OF TAILORING CONSTRUCTION (3)
403. FITTING AND PATTERN ADJUSTMENT (3)
404. DRESS DESIGN (3)
- 405, 405X. FASHION MERCHANDISING (3)
406. FASHION PROMOTION OF TEXTILES AND CLOTHING (3)
407. THE TEXTILE AND CLOTHING INDUSTRY (3)
408. TEXTILES (3)
- 409, 409X. COSTUME SELECTION (3)

COMMERCE

PROFESSOR RALPH H. WHERRY, M.A., C.L.U.

Head of the Department

500. CASE STUDIES IN BUSINESS ADMINISTRATION (3) Case studies of business and management policy with respect to procurement, production, selling, finance, accounting, relations with government, labor, and the public.
501. COMMERCE SEMINAR (3-6) Reports on research in selected fields of commercial activities.
502. SEMINAR IN BUSINESS MANAGEMENT (3)
503. TRANSPORTATION AND PUBLIC UTILITY SEMINAR (3)
Professor Waters
506. SEMINAR IN INVESTMENTS AND CORPORATION FINANCE (3)
515. TRANSPORTATION RATES AND BUSINESS (3) Rate making and rate changes and their effects on business location and development. Prerequisite: Com. 15.
Professor Waters
517. INTERNATIONAL BUSINESS PRACTICES (3) Practices of exporters and importers dealing in commodities traded in world markets under competition, monopoly, or governmental control. Prerequisite: Com. 17.
Professor Hench

COMMERCE

523. SEMINAR IN MARKETING (3-6) Research in modern marketing trends.
Professor Hilgert
525. CASE STUDIES IN INSURANCE (3) Analysis of management's insurance problems, such as the feasibility of self-insurance; proper allocation of insurance premiums and coverage in selected industries, etc. Prerequisites: Com. 25, 33.
Professor Wherry
526. ADVERTISING SEMINAR (3) Advertising budgeting, selection of media, appraisal of effectiveness, co-ordination of advertising and selling efforts. Prerequisite: Com. 23.
Professor Hilgert
529. SEMINAR IN RETAILING (3)
Professor Einstein
536. SALES MANAGEMENT SEMINAR (3) Principles of sales planning and administration; co-ordination of selling with advertising, promotion, production, and accounting; use of market research selling costs and budgets.
Professor Hilgert

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 401. INDUSTRIAL PURCHASING (3) | <i>Professor Babione</i> |
| 405. ANALYSIS OF FINANCIAL STATEMENTS (3) | <i>Professor Bradley</i> |
| 406. INVESTMENT ANALYSIS (3) | <i>Professor Malott</i> |
| 407. INVESTMENT BANKING (3) | <i>Professor Bradley</i> |
| 410. BANK MANAGEMENT (3) | <i>Professor McKinley</i> |
| 415. REGULATION OF TRANSPORT CARRIERS (3) | <i>Professor Waters</i> |
| 417. FOREIGN MARKETS (3) | <i>Professor Reedy</i> |
| 422. SALES PROMOTION (3) | <i>Professor Decker</i> |
| 424. MARKETING RESEARCH (3) | <i>Professor Hilgert</i> |
| 425. INSURANCE AGENCY MANAGEMENT (3) | <i>Professor Wherry</i> |
| 426. STORE MANAGEMENT AND OPERATION (3) | <i>Professor Einstein</i> |
| 427. RETAIL BUYING AND MERCHANDISING (3) | <i>Professor Einstein</i> |
| 428. RETAIL ADVERTISING AND SALES PROMOTION (3) | <i>Professor Einstein</i> |
| 430. ADVANCED BUSINESS LAW (3) | <i>Professor Phalan</i> |
| 436. FUNDAMENTALS OF SALES MANAGEMENT (3) | <i>Professor Hilgert</i> |
| 461. CASE STUDIES IN AMERICAN INDUSTRIES (3) | <i>Professor Mares</i> |
| 476. ADVANCED BUSINESS MANAGEMENT (3) | <i>Professor Hurley</i> |
| 477. ADMINISTRATIVE MANAGEMENT (3) | |

COMMERCIAL CONSUMER SERVICES

PROFESSOR MARY BROWN ALLGOOD, M.S.

Chairman of the Division

The following courses may be taken for graduate credit under the restrictions in force:

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| 403. LECTURE-DEMONSTRATION TECHNIQUES (3) | <i>Professor Allgood</i> |
| 450. PROBLEMS IN HOUSEHOLD EQUIPMENT (1-6) | <i>Professor Allgood</i> |

COMPARATIVE LITERATURE

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.

Chairman of the Committee in Charge

500. SEMINAR IN COMPARATIVE LITERATURE (3-6)

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

400. COMPARATIVE METHOD IN LITERARY STUDIES (3)

443. (Ger. 443). LITERARY RELATIONS OF GERMANY WITH ENGLAND
AND AMERICA (3-9) *Professor Shelley*

480. INTRODUCTION TO FOLKLORE (3) *Professor Bayard*

DAIRY SCIENCE

PROFESSOR DONALD V. JOSEPHSON, M.S., Ph.D.

Head of the Department

501. BUTTER AND CHEESE (1-6) Manufacture and handling of butter and cheese. Prerequisites: D.Sc. 10, 23, Bact. 8, A.B.Ch. 403. *Professor Dahle*

502. CONDENSED MILK AND MILK POWDER (1-6) Condensing and drying of milk. Prerequisites: D.Sc. 10, 26, Bact. 8, A.B.Ch. 403. *Professor Doan*

503. PUBLIC MILK PROBLEMS (1-6) Handling milk in modern plants. Prerequisites: D.Sc. 11, Bact. 8, A.B.Ch. 403. *Professor Doan*

504. ICE CREAM MANUFACTURE (1-6) Manufacture of ice cream, ices, and other frozen milk products. Prerequisites: D.Sc. 11, Bact. 8, A.B.Ch. 403. *Professor Dahle*

505. DAIRY PLANT ECONOMICS (1-6) Economic factors involved in creamery operation and management. Prerequisites: D.Sc. 7, 11. *Professor Dahle*

507. DAIRY CATTLE MANAGEMENT (1-6) Management of dairy cattle. Prerequisite: D.Sc. 27. *Professor Williams and Staff*

508. DAIRY SEMINAR (1-6) Preparation and presentation of a paper on an assigned subject. *Professor Josephson and Staff*

509. TESTING DAIRY PRODUCTS (1-6) Constituents of dairy products. Prerequisites: D.Sc. 11, Bact. 8, A.B.Ch. 403. *Professor Doan*

510. DAIRY CATTLE FEEDING (1-6) Application of fundamental research in animal nutrition to the feeding of dairy cattle. Prerequisites: D.Sc. 1, 29. *Professor Williams*

511. DAIRY CATTLE NUTRITION (1-6) Nutritional requirements of dairy cattle. Prerequisites: A.Ntr. 401, 402.

DAIRY SCIENCE

512. ADVANCED STUDIES IN MILK SECRETION (1-6) Physiology of milk secretion. Prerequisite: D.Sc. 427.
513. DAIRY CATTLE SELECTION (1-6) Breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.Sc. 1, 30.
515. ADVANCED PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (1-6) Reproduction of farm animals. *Professor Almquist*
516. ARTIFICIAL BREEDING OF FARM ANIMALS (1-6) Prerequisite: D.Sc. 431. *Professor Almquist*
517. DAIRY HUSBANDRY LITERATURE (1-6) Review and reporting of dairy literature. *Professor Josephson and Staff*
522. RESEARCH PROCEDURES IN DAIRY TECHNOLOGY (3) Research problems and methods in dairy technology with major emphasis on dairy chemistry. Prerequisite: A.B.Ch. 403.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

418. DAIRY SURVEY (1) *Professor Josephson*
421. DAIRY MANUFACTURING PROBLEMS (1-6) *Professors Dahle, Doan, and Staff*
427. MILK SECRETION (3)
428. DAIRY PRODUCTION PROBLEMS (1-3)
430. TECHNICAL CONTROL OF DAIRY PRODUCTS (4) *Professor Watrous*
431. PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS *Professor Almquist*

DRAMATICS

501. PROBLEMS OF DIRECTING (3-6) Seminar in problems of production with particular stress on direction. Students will direct plays under staff supervision.
502. SEMINAR IN THE TECHNICAL PROBLEMS OF DRAMATIC PRODUCTION (3-6) Prerequisite: Dram. 11.
504. SEMINAR IN STYLES OF ACTING (3-6) Practical work required of each student.
506. EVALUATION AND APPRECIATION OF MODERN DRAMATIC ENTERTAINMENT (3) Prerequisites: Dram. 1, 61.
507. SEMINAR IN FUNDAMENTAL THEORIES OF THEATER AND DRAMA (3-6)
521. PLAYWRITING (3-6) Prerequisites: Dram. 21, 421.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 403. ADVANCED MAKE-UP (1)
- 404. STYLES OF ACTING (3)
- 412. ADVANCED SCENE DESIGN (3)
- 413. ADVANCED STAGE LIGHTING (3)
- 421. ADVANCED PLAYWRITING (3)
- 431. HISTORY OF THE THEATER (3)
- 442S. EDUCATIONAL DRAMATICS (3)
- 443S. EDUCATIONAL DRAMATICS (ADVANCED MARIONETTES) (3)
- 451. DIRECTING (3)
- 452. CENTRAL STAGING (3)
- 480. RADIO DRAMA (3)
- 481. ADVANCED RADIO DRAMA (3)

ECONOMICS

PROFESSOR HOWARD A. CUTLER, M.A., Ph.D.

Head of the Department

- 500. ECONOMICS SEMINAR (3-6)
- 501. RESEARCH METHODS IN ECONOMICS (3-6)
- 507. SEMINAR IN INTERNATIONAL ECONOMICS: THEORY AND POLICY (3-6)
- 508. SEMINAR IN MONEY, CREDIT, AND PUBLIC FINANCE (3-6) Prerequisite: Econ. 51.
- 510. DEMAND ANALYSIS (3) *Professor Mendelson*
- 511. SEMINAR IN INDUSTRIAL DISPUTES (3) Prerequisites: Econ. 14, 15. *Professor Myers*
- 515. LABOR SEMINAR (3) *Professor Reede*
- 522. ADVANCED ECONOMIC THEORY (3-6) Theory of price and income determination. Prerequisite: Econ. 405. *Professor Mendelson*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 400. HISTORY OF ECONOMIC THOUGHT (3) *Professor Liebhafsky*
- 401. RECENT ECONOMIC THOUGHT (3) *Professor Liebhafsky*
- 405. INTERMEDIATE ECONOMIC THEORY (3) *Professor Fouraker*
- 412. ECONOMICS OF COLLECTIVE BARGAINING (3) *Professor Myers*
- 415. SOCIAL INSURANCE (3)
- 418. ECONOMICS OF WAGES AND EMPLOYMENT (3) *Professor Belfer*
- 419. CASE STUDIES IN LABOR-MANAGEMENT RELATIONS (3) *Professor Reede*
- 423. PENNSYLVANIA LOCAL AND STATE FINANCE (3) *Professor Stout*
- 425. THE MONEY MARKET (3) *Professor McKinley*
- 426. FISCAL POLICY (3)
- 427. MONETARY THEORY AND POLICY (3)
- 430. NATIONAL PLANNING (3)

ECONOMICS

431. HOUSING AND COMMUNITY DEVELOPMENT (3)
433. INTERNATIONAL MONETARY ECONOMICS (3) *Professor Reedy*
434. INTERNATIONAL TRADE AND PUBLIC POLICY (3) *Professor Reedy*
442. STRUCTURE OF THE ECONOMY AND PUBLIC POLICY (3) *Professor Herman*
450. THE BUSINESS CYCLE (3)
480. MATHEMATICAL ECONOMICS (3) *Professor Mendelson*
490. MEASUREMENT OF THE ECONOMY (3) *Professor Saylor*
499X. FOREIGN STUDY IN ECONOMICS (2-6)

EDUCATION

PROFESSOR CHARLES M. LONG, M.A., D.Ed.

Head of the Department

501. INTRODUCTION TO THE ADVANCED STUDY OF EDUCATION (1-3) Methods of educational research; criticism of studies and theses in education; initiating research projects; summarizing results of research. Prerequisite: Ed. 470 or Psy. 415. *Professor Davison*
502. SUPERVISED EXPERIENCE IN STUDENT COUNSELING (3) Practice in the application of guidance principles and methods to cases counseled under supervision; case conferences; seminar in guidance techniques. Prerequisite: Ed. 453. *Professor Wellington*
503. SUPERVISION OF GUIDANCE WORKERS (3) Practical experience in supervising and evaluating work of counselors. Prerequisite: Ed. 502. *Professor Wellington*
504. ORGANIZATION AND ADMINISTRATION OF GUIDANCE PROGRAMS (3) Principles, organization, personnel, functions, integration with school program, evaluation. *Professor Wellington*
505. OCCUPATIONAL AND EDUCATIONAL INFORMATION (3) Occupational information for guidance purposes, educational information related to vocational choice and preparation. Prerequisite: Ed. 453. *Professor Wellington*
506. DEVELOPING ANALYSES OF THE INDIVIDUAL FOR VOCATIONAL COUNSELING (3) Collection and use of data basic to the counselor's understanding of individuals; the counseling interview and techniques other than testing. *Professor Wellington*
510. INTERNSHIP IN PROFESSIONAL EDUCATION (1-9) Internship to take place in schools or educational situations where not regularly employed under supervision of graduate faculty.
Unit A. Administration and Supervision (1-6)
Unit B. College Teaching (3-6)
Unit C. Public School Research (3-6)
Unit D. Elementary Teaching (3-6)
Unit E. Secondary Teaching (3-6)

- Unit F. *Art Teaching and Supervision* (3-6)
 Unit G. *Business Education Supervision* (3-6)
 Unit H. *Special Education Supervision* (3-6)
 Unit I. *Audio-Visual Education* (3-6)

515. COMPARATIVE EUROPEAN EDUCATION (3) Educational policies and practices in school systems in western and central European nations. Prerequisite: Psy. 14. *Professors Chiappetta and Russell*

516. SOCIAL FOUNDATIONS OF THE CURRICULUM (2-4) Analysis of societal needs as a basis for educational programs; contributions of public education to social advancement. Prerequisites: Ed. 25, Psy. 14. *Professor McNerney*

517. EVOLUTION OF EDUCATIONAL THOUGHT (2-3) Rise of formal educational philosophy from Plato to John Dewey; preliminary reference to Chinese, Hindu, Chaldean, Persian, Hebrew, and Egyptian theories.

523. LABORATORY IN ORGANIZATIONAL ASPECTS OF MATERIALS OF INSTRUCTION (1-3) Organizing, storing, circulating, and maintaining instructional materials in an instructional materials library. Prerequisites: Ed. 424, 585. Conference 1 hour, alternate weeks by appointment.

Professor VanderMeer

524. SEMINAR IN CURRICULUM MATERIALS AND THEIR UTILIZATION (3) Advanced detailed analysis of mass communication media; relationships among these and educational objectives, individual differences in learners, and ideas to be communicated. Prerequisites: Ed. 424, 585, 6 credits in educational psychology.

Professor VanderMeer

525. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3) Study of science supporting dynamic instruction; principles of teaching as guides; analysis of modern procedures; understanding of learning; substance versus plans. Prerequisite: 12 credits of undergraduate work in education.

Professors Butler and Russell

527. PROBLEMS IN THE EDUCATION OF THE MENTALLY RETARDED (1-4) Study of existing curriculums, instructional practices, educational programs; experimentation in curriculum building and materials construction. Prerequisites: Ed. 426 or 583, Unit P, and Ed. 427 and teaching experience.

Professor Neuber

529. PROBLEMS IN THE EDUCATION OF THE MENTALLY GIFTED (1-4) Analysis of educational needs of mentally gifted; curriculum construction and curricular materials. Prerequisites: teaching experience and Ed. 426 or 583, Unit P, and 429.

Professor Neuber

532. SUPERVISION OF STUDENT TEACHERS (3) A course in supervision for master teachers, department heads, and college teachers with supervisory responsibilities in teacher education. Prerequisite: experience in teaching and 18 credits in education, including at least 5 in methods. *Professor Moyer*

534a. READING CLINIC PRACTICE: ANALYSIS OF READING DISABILITIES (1-9) A laboratory course consisting of analysis of extreme reading disabilities and recommended remedial procedures; experience in preparation of case reports. Prerequisite: Ed. 432g or Psy. 550. *Professor Hunt*

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- 534b. **READING CLINIC PRACTICE: REMEDIAL PROCEDURES (1-9)** Practicum in special classes for reading disabilities; corrective and remedial procedures; specific procedures for correction of various types of reading disabilities. Prerequisite: Ed. 432g or 534a. *Professor Hunt*
535. **SEMINAR ON READING INSTRUCTION (2-12)** Designed to appraise significant researches and to outline procedures and materials for research; reading readiness, word perception, basic reading skills, vocabulary development. Prerequisite: Ed. 432b or 432c. *Professor G. E. Murphy*
536. **READING CLINIC RESEARCH (1-15)** Prerequisites: Ed. 432b; or Ed. 432c, 432g. *Professor G. E. Murphy*
540. **PROBLEMS OF ELEMENTARY EDUCATION (2-3)** Problems seminar for experienced educators. Prerequisite: 12 credits in education and psychology, including 6 in elementary education.
541. **SEMINAR IN CONTEMPORARY ISSUES IN ELEMENTARY EDUCATION (1-3)** Conferences and discussions designed to meet the needs of experienced teachers and principals in the field of elementary education. Prerequisite: 6 credits in elementary education and teaching experience.
546. **ELEMENTARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3)**
548. **ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3)** Principles underlying curriculum construction. Primarily for elementary education majors. Prerequisite: Ed. 31 or teaching experience.
550. **PROBLEMS IN MODERN SECONDARY EDUCATION (1-4)** Historical, psychological, social, and economic factors influencing secondary education; required as basic course of all graduate students in secondary education. Prerequisite: secondary school teaching. *Professor Butler*
551. **SEMINAR IN CONTEMPORARY ISSUES IN SECONDARY EDUCATION (2-9)** *Professor McNerney*
- Unit A. The Secondary School Curriculum (2-3)* Principles and philosophy of curriculum construction. Each student works out an individual problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience.
- Unit B. Laboratory Studies in Application of Educational Method (2-3)* Analysis and application of outstanding studies in secondary education; integration of results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.
- Unit C. Organization and Administration of Secondary Education (2-3)* Problems in reorganization of secondary education, with particular reference to philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology, and teaching experience.
556. **THE SECONDARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3)** Improvement of instruction; improvement of teachers in service; evaluation of teach-

ing procedures; methods of supervision; selection and use of textbooks. Prerequisite: three years' teaching experience.

561. THE COMMUNITY COLLEGE AND POST-SECONDARY SCHOOL EDUCATION (2-3) Philosophy, organization, and character of school programs needed to meet educational needs of individuals who desire to continue their education on the post-secondary school level. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. *Professor Patrick*
562. THE INSTRUCTIONAL PROGRAM IN COMMUNITY COLLEGES AND POST-SECONDARY EDUCATION (2-3) Course offerings, curriculums, instructional materials and procedures, guidance, extracurricular activities, student personnel, evaluation of results, and faculty qualifications. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. *Professor Patrick*
563. THE PROFESSIONAL EDUCATION OF TEACHERS (3) Development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff. Prerequisite: 6 credits in advanced courses in education and a course in educational psychology.
564. RECENT TRENDS IN HIGHER EDUCATION (2-3) Factors affecting current college enrollment, organization, administration, support, and curriculums, with special emphasis on general education, its development, aims, and forms.
565. THE PRINCIPLES OF COLLEGE TEACHING (2-3) Principles involved in teaching at the college level; effective use of teaching aids; criteria used in evaluation.
566. STUDENT PERSONNEL PROGRAMS AT THE COLLEGE LEVEL (2-3) Student personnel services in higher education; organization of student advisory programs; use of personnel data; co-curricular activities; student welfare. *Professor Wellington*
567. GROWTH AND ORGANIZATION OF HIGHER EDUCATION (2-3) Growth of higher education; influence of church, state, federal government; educational, social, and economic factors that have affected curriculums and organization of institutions.
568. CURRICULUMS IN HIGHER EDUCATION (2-3) Various types of curriculums and philosophies underlying them; ways in which curriculums are developed; elective versus required courses; evaluation of achievement.
569. SEMINAR IN COLLEGIATE EDUCATION (1-6) Special topics in higher education. Prerequisite: Ed. 567. *Professor Weaver*
574. ADVANCED EDUCATIONAL STATISTICS (2-4) Appropriate measures and devices for experimental research in education including correlation measures, curve fitting, and analysis of variance. Prerequisite: 12 credits of graduate work in education including Ed. 470 or Psy. 415. *Professor Davison*
575. ADMINISTRATION AND SUPERVISION IN BUSINESS EDUCATION (3) Work of administrators, supervisors, and others responsible for improve-

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ment of instruction in business education; use of vocational testing; job analysis. Prerequisite: 6 credits in secondary education.

Professors Gemmell and Veon

576. INTRODUCTION TO RESEARCH IN BUSINESS EDUCATION (3) Methods of research in business education; opportunity to compile annotated bibliographies on current problems; analysis and evaluation of significant research.
Professor Gemmell

577. EVALUATION OF RESEARCH AND EMPIRICAL LITERATURE IN BUSINESS EDUCATION (3) Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576.
Professor Gemmell

578. SEMINAR IN BUSINESS EDUCATION (3) Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577.
Professor Gemmell

580. SEMINAR IN SCHOOL ADMINISTRATION (1-6) Efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, stimulating co-operative work. Prerequisite: Ed. 480, 6 credits of Ed. 583.

582. EDUCATIONAL SURVEY TECHNIQUES (2-3) Methods for appraisal of an educational program; planning for expansion, consolidation, or reduction of educational offerings. Prerequisites: Ed. 480, 6 credits of Ed. 583.

- 583, 583X. PROBLEMS IN ADMINISTRATION AND SUPERVISION (2-25) Prerequisite: Ed. 480 or teaching or administrative or supervisory experience.

Unit A. The Educational Plant (2-3)

Unit B. Public Relations for School Administrators (2-3)

Unit C. Public School Finance (2-3)

Unit F. State and National Education Programs (2-3)

Unit I. Administration of Adult Education in the Public Schools (3)

Unit M. Legal Aspects of School Administration (3)

Unit P. The Administration of Public School Education for Atypical Children (2)

Unit Q. Dynamic Factors in School Administration (2-3)

Unit R. Public School Business Administration (2-3)

585. CURRICULUM CONSTRUCTION (2-3) Functions of administrators, supervisors, teachers, pupils, and laymen in curriculum building to meet pupil and community needs.
Professor McGarey

586. PRINCIPLES OF SCHOOL SUPERVISION (2-3) Organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests and teacher rating. Prerequisite: 18 credits in education and 3 years' teaching experience.
Professor McNerney

587. THE SECONDARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-4) Problems of schedule making, teachers' meetings, curriculum making and revision, organization of extracurricular and guidance programs. Prerequisite: teaching experience.

589. THE ELEMENTARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-3)
Duties of the elementary school principal in organizing and administering his school. Prerequisite: Ed. 442.
590. PHILOSOPHY OF EDUCATION (2-4) Fundamental principles; scientific sanctions of progressive instructional practices and professional experiences as bases for formulation of the educational creed. Prerequisite: 18 credits in education.
Professor Chiappetta
591. EDUCATION IN RUSSIA, ASIA, AND THE MIDDLE EAST (2-3) Current educational activities in Soviet Russia and other eastern European countries; the Middle East, North Africa, and the Far East.
Professor Chiappetta
592. EDUCATION IN THE LATIN-AMERICAN COUNTRIES (2-3) Recent educational progress in Central and South America, with special reference to Mexico, Cuba, Puerto Rico, Brazil, Chile, and Argentina.
594. SEMINAR IN EDUCATION (1-3) Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: 12 credits of graduate work in education.
Professors Long, Davison, and Russell
- 597S. WORKSHOP IN CURRENT EDUCATIONAL PROBLEMS (1-6) For administrators, supervisors, experienced elementary and secondary teachers, guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Prerequisite: 12 credits of graduate work in education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 413, 413X. HISTORY OF EDUCATION IN THE UNITED STATES (2-3)
415S, 415X. MODERN TENDENCIES IN AMERICAN EDUCATION (1-6)
416X. SOCIAL EDUCATION (3)
421X. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)
424, 424X. VISUAL AND OTHER SENSORY AIDS FOR TEACHERS (1-3)
Professor VanderMeer
- 425S, 425X. THE SCIENTIFIC DIRECTION OF LEARNING ACTIVITIES (2-4)
426, 426X. EDUCATION OF EXCEPTIONAL CHILDREN (2-3)
Professor Neuber
427. EDUCATION OF THE MENTALLY RETARDED (2-3) *Professor Neuber*
428, 428X. ADULT EDUCATION: ORGANIZATION, TYPES, AND METHODS (1-3)
Professor Cologne
Unit A. *History, Philosophy, and General Organization and Administration of Adult Education* (1)
Unit B. *Types of Adult Education: Parental Education* (1)
Unit C. *Methods in Adult Education and Leadership of Discussion Groups* (1)
- 429, 429X. EDUCATION OF THE MENTALLY GIFTED CHILD (1-3)
Professor Neuber
- 430, 430X. VISUAL AND OTHER AIDS IN SAFETY EDUCATION (3)
432b, 432bX. THE ELEMENTARY SCHOOL READING PROGRAM (2-3)
Professors G. E. Murphy and L. C. Hunt

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- 432c, 432cX. READING PROBLEMS IN THE SECONDARY SCHOOL (2-3)
Professors G. E. Murphy and L. C. Hunt
- 432d, 432dX. SPECIAL PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL ENGLISH (2-3)
Professor G. E. Murphy
- 432eX. CHORAL SPEAKING (3)
Professor G. E. Murphy
- 432f, 432fX. TEACHING SECONDARY SCHOOL ENGLISH (2-3)
Professor G. E. Murphy
- 432g, 432gX. READING DISABILITIES (2-3)
Professor Hunt
- 432h, 432hX. TECHNIQUES IN REMEDIAL READING (2-6)
Professor Hunt
- 433e. ADVANCED THEORY OF KINDERGARTEN (3)
Professor Graffius
- 433f, 433fX. TEACHING CHILDREN'S LITERATURE (2-3)
Professor G. E. Murphy
- 433h, 433hX. PROBLEMS OF ELEMENTARY SCHOOL ARITHMETIC (2-3)
- 433n, 433nX. TEACHING SOCIAL STUDIES IN THE ELEMENTARY GRADES (2-3)
- 433w, 433wX. TEACHING SOCIAL STUDIES IN THE HIGH SCHOOL (2-3)
Professor VanderMeer
- 433y, 433yX. TEACHING MATHEMATICS IN THE SECONDARY SCHOOL (3)
- 435X. EDUCATION FOR CITIZENSHIP (2-3)
- 438, 438X. TEACHING SCIENCE IN SECONDARY SCHOOLS (2-3)
Professor Alfke
- 438e, 438eX. TEACHING SCIENCE IN THE ELEMENTARY SCHOOL (1-3)
- 439, 439X. TEACHING TRAFFIC SAFETY AND AUTOMOBILE OPERATION (3)
Professor Neyhart, Mr. Intorre
- 440, 440X. ORGANIZATION AND SUPERVISION IN SAFETY EDUCATION (3)
- 441X. PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS (2-3)
- 442, 442X. ELEMENTARY EDUCATION (2-3)
445. PRODUCTION OF VISUAL AND AUDITORY MEDIA (2-9)
Unit A. Preparation of Educational Still Pictures (2-3)
Unit B. Scripting and Shooting Educational Motion Pictures (2-3)
Unit C. Editing and Sound Recording in the Production of Educational Motion Pictures (2-3)
446. DIAGNOSIS OF ATTAINMENT (3)
Professor Cobb
- 448X. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3)
- 449aS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3)
Professor Free
- 449bS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3)
Professor Free
- 450X. SECONDARY EDUCATION (2-3)
Professor Butler
- 451X. SPECIAL PROBLEMS OF THE HIGH SCHOOL TEACHER (2-3)
- 453, 453X. GUIDANCE PRINCIPLES AND PRACTICES (3)
Professor Wellington
- 454, 454X. EXTRACURRICULAR ACTIVITIES IN THE JUNIOR AND SENIOR HIGH SCHOOL (2-3)
Professors Moyer and Patrick
- 456, 456X. PRINCIPLES AND PROBLEMS IN BUSINESS EDUCATION (1-3)
Professors Gemmell and Veon
- 459, 459X. IMPROVEMENT OF INSTRUCTION IN BUSINESS SKILL SUBJECTS (1-3)
Professor Gemmell
460. CURRICULUMS IN BUSINESS EDUCATION (3)
Professor Gemmell
461. IMPROVEMENT OF INSTRUCTION IN BASIC BUSINESS SUBJECTS (3)
Professor Gemmell

462. TEACHING OF SHORTHAND AND TYPEWRITING (3) *Professor Gemmell*
463. TEACHING OF BOOKKEEPING (3) *Professors Gemmell and Veon*
464. METHODS OF TEACHING DISTRIBUTIVE EDUCATION (3)
466. TEACHING OF OFFICE PRACTICE (3) *Professor Veon*
467. TEACHING OF SHORTHAND (2-3) *Professor Veon*
468. TEACHING OF TYPEWRITING (2-3) *Professor Veon*
- 470, 470X. EDUCATIONAL MEASUREMENTS (2-3) *Professor Davison*
- 474, 474X. TEACHING AND GROUP GUIDANCE ABOUT OCCUPATIONS (3) *Professor Corle*
- 480, 480X. EDUCATIONAL ADMINISTRATION (2-3) *Professors Miller and Remaley*
- 482X. SUPERVISION AND IMPROVEMENT OF INSTRUCTION (2-3)
- 485X. CURRICULUM CONSTRUCTION (2-3)
- 487, 487X. PROBLEMS IN VISUAL AND OTHER SENSORY AIDS IN EDUCATION (1-14) *Professor VanderMeer*
- Unit A. *Organization and Administration of Visual-Sensory Aids Programs* (1-3)
- Unit B. *Motion Pictures in Education* (2-3)
- Unit C. *Radio and Television in Education* (3)
- Unit D. *Still Pictures* (1-2)
- Unit E. *Advanced Audio-Visual Equipment* (3)
- 490X. PHILOSOPHY OF EDUCATION (3)
- 491X. SCHOOL LAW (3)
- 493, 493X. CHARACTER EDUCATION AND GUIDANCE (2-3) *Professor Chiappetta*
494. RELIGIOUS EDUCATION (2-3)
- 495S. (Ch.Fm. 495S, Hl.Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)
- 497S, 497X. WORKSHOP IN SELECTED STUDIES IN ELEMENTARY AND SECONDARY EDUCATION (1-6)
- 498, 498X. PRACTICUM IN THE EDUCATION OF ATYPICAL CHILDREN (3-6)
- Unit A. *The Mentally Retarded (Elementary)* (3)
- Unit B. *The Older Mentally Retarded (Secondary)* (3)
- Unit C. *The Mentally Gifted* (3)
- Unit D. *The Emotionally and Socially Maladjusted* (3)
- Unit E. *The Physically Delicate* (3)
- 499, 499X. PROBLEMS OF SPECIAL EDUCATION (3) *Professor Neuber*

ELECTRICAL ENGINEERING

PROFESSOR ARTHUR H. WAYNICK, M.S., Sc.D.

Head of the Department

520. SEMINAR (1) Required of all graduate students in electrical engineering. Conferences, reading, and presentation of technical papers.
- 521a,b,c,d. ALTERNATING-CURRENT THEORY (2-12) Special problems in alternating-current theory and application of these problems to alternating-current circuits or machinery at any frequencies.

ELECTRICAL ENGINEERING

522. PUBLIC UTILITIES (3) Problems in the public utility field, especially those involving electrical engineering. *Professor Powell*
523. TRANSIENTS IN LINEAR SYSTEMS (3) Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E.E. 423. *Professor Holt*
524. ENGINEERING ELECTRONICS (3) Special problems dealing with design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program. *Professor Stavelly*
525. SYMMETRICAL COMPONENTS (3) Polyphase circuits and machines under unbalanced conditions of operation including effects of rotating machines upon distribution and transmission system performance; characteristics of phase converters and single-phase operation of polyphase systems. Prerequisite: E.E. 425. *Professor Holt*
528. SERVOMECHANISMS (3) Advanced treatment of transient and steady-state behavior of closed-cycle control systems with special attention to stability and design of stabilizing controllers. Prerequisite: E.E. 428. *Professor Tarpley*
530. AUDIO FREQUENCY ENGINEERING (3) Electrical systems and equipment used in production, recording, amplification, transmission, and measurement of sound. Prerequisite: E.E. 11 or 13.
- 531a,b,c. RADIO FREQUENCY ENGINEERING (3-9) Radio frequency equipment, measurements, and systems; amplifiers, modulators, demodulators, transmitters, receivers, transmission lines, antennae, and radiators. Prerequisite: E.E. 440.
532. ULTRA-HIGH-FREQUENCY ENGINEERING (4) Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E.E. 432. *Professor Hall*
533. AUTOMATIC CONTROL SYSTEMS (2-3) Automatic control, telemetering, and recording of electrical, mechanical, thermal, and chemical quantities. Prerequisite: E.E. 4.
535. ENGINEERING ANALYSIS (3) Engineering applications of complex variables, conformal mapping methods and potential plotting. Laplace transform methods and stability criteria. Prerequisite: E.E. 435.
538. ELECTROMAGNETIC ENGINEERING (3) Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E.E. 438.
550. COMMUNICATION NETWORKS (3) Methods of filter design using lattice networks; effects of dissipation on characteristics of filter networks; transient response of networks and design of equalizers. Prerequisite: E.E. 450. *Professor Tarpley*

ELECTRICAL ENGINEERING

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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|-------------|---|---------------------|
| 421a,b,c,d. | ELECTRICAL ENGINEERING PROBLEMS (2-12) | |
| 423. | TRANSIENT PHENOMENA (3) | Professor Holt |
| 424. | POWER FREQUENCY ELECTRONICS (3) | Professor Shields |
| 425. | SYMMETRICAL COMPONENTS (3) | Professor Holt |
| 426. | TRANSISTORS (3) | Professor Riddle |
| 428, 428X. | SERVOMECHANISMS (3) | Professor Tarpley |
| 432. | ULTRA-HIGH-FREQUENCY TECHNIQUES (3) | Professor Hall |
| 434. | INDUSTRIAL ELECTRONICS (3) | Professor Stavely |
| 435, 435X. | ENGINEERING ANALYSIS (3) | Professor Tarpley |
| 436. | DESIGN, CONSTRUCTION, AND TESTING OF VACUUM TUBES (3) | Professor Nearhoof |
| 438. | FUNDAMENTALS OF ELECTRIC WAVES (3) | Professor Mentzer |
| 440. | VACUUM-TUBE CIRCUITS I (3) | |
| 441. | VACUUM-TUBE CIRCUITS II (3) | |
| 450, 450X. | ELECTRICAL NETWORK THEORY (3) | Professor Tarpley |
| 460. | HIGH-VOLTAGE ENGINEERING (3) | Professor Armington |
| 461. | FUNDAMENTALS OF POWER SYSTEM STABILITY (3) | Professor Shields |

ELECTRICAL ENGINEERING LABORATORY

PROFESSOR ARTHUR H. WAYNICK, M.S., ScD.

Head of the Department of Electrical Engineering

The following courses may be taken for graduate credit under the restrictions in force:

- 440. ELECTRICAL COMMUNICATIONS LABORATORY I (1½)
- 441. ELECTRICAL COMMUNICATIONS LABORATORY II (1½)

ENGINEERING

Consult DEAN ERIC A. WALKER, S.M., Sc.D., P.E.

The following courses may be taken for graduate credit under the restrictions in force:

- 400. PRODUCTION ENGINEERING (3)
- 410. NUCLEAR ENGINEERING (3)
- 411. NUCLEAR ENGINEERING (3)
- 422. ORDNANCE ENGINEERING: TORPEDO ENGINEERING (3)

ENGINEERING MECHANICS

PROFESSOR JOSEPH MARIN, M.S., Ph.D., P.E.

Head of the Department

500. ADVANCED MECHANICS OF MATERIALS (3-6) Strain energy methods; special problems in bending and torsion; curved bars, beams on elastic foundations; thick-walled cylinders, shrink-fit assemblies, and rotating discs; thin-walled pressure vessels; bending of thin plates; buckling of bars and plates. Prerequisite: Mchs. 13. *Professors Marin and Hardenbergh*
504. APPLIED ELASTICITY (3) Analyses of stress and strain in two dimensions; problems in elasticity and elastic stability; emphasis on applications to machine and structural design. Prerequisite: Mchs. 13. *Professor Marin*
506. EXPERIMENTAL STRESS ANALYSIS (3) Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; stress analogies; strain rosettes for combined stress determinations. Prerequisite: Mchs. 13. *Professors Marin and Hu*
507. THEORY OF ELASTICITY AND APPLICATIONS (3-6) General equations of stress and strain; applications to beams, curved members, rotating discs, thick cylinders, torsion members, plates, and other structural and machine parts. Prerequisite: Mchs. 13. *Professor Rongved*
508. THEORY OF ELASTIC STABILITY AND APPLICATIONS (3) Buckling of slender and short members; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to internal pressures; applications to structural parts including aircraft members. Prerequisites: Mchs. 12, 13.
509. THEORY OF PLATES AND SHELLS (3) Bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without bending; applications to engineering problems. Prerequisite: Mchs. 13. *Professors Davids and Rongved*
514. ENGINEERING MECHANICS SEMINAR (1 per semester) Current literature and special problems in engineering mechanics.
520. ADVANCED DYNAMICS (3) Dynamics of a particle and of rigid bodies; Newtonian equations in moving co-ordinate systems; LaGrange's and Hamilton's equations of motion; special problems in vibrations and dynamics. Prerequisites: Mchs. 12, Math. 84 or 431. *Professors Davids and Sauer*
522. THEORY OF VIBRATIONS (3) Mathematical theory of vibrating systems; damping phenomena; forced vibrations; analogy between mechanical and electrical vibrations; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: Mchs. 13, Math. 84 or 431. *Professor Vierck*

ENGINEERING MECHANICS

523. RELAXATION METHODS (3) Relaxation methods compared to iteration and other numerical methods of analysis; application to elasticity, plasticity, stability, fluid flow, heat transfer, and related fields. Prerequisite: Mchs. 522. *Professor Vierck*

524. MATHEMATICAL METHODS IN ENGINEERING (3-6) Prerequisite: Math. 451 or E.E. 435 or M.E.Des. 404. *Professor Davids*

Unit A (3) Matrix and tensor analysis, finite differences, relaxation, perturbation, and other approximate methods in solution of various engineering problems.

Unit B (3) Energy methods, potentials, application to torsion problems, nonlinear problems, analogies and dimensional analysis, Bessel and other special functions, harmonic analysis.

528. EXPERIMENTAL METHODS IN VIBRATIONS (3) Investigation of one or more degrees of freedom, free and forced mechanical vibrations, vibration properties of materials, vibration techniques in nondestructive testing. Prerequisite: Mchs. 401 or 522. *Professor Brennan*

530. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for static and fatigue stresses; impact loads; creep of metals; applications to structural and machine design. Prerequisite: Mchs. 14. *Professor Marin*

531. THEORY OF PLASTICITY AND APPLICATIONS (3) Theory of plasticity including plastic torsion and bending of bars; thick-walled cylinders and rotating discs; buckling of bars and residual stresses; mechanics of creep. Prerequisite: Mchs. 504 or 507. *Professor Marin*

533. DETERMINATION OF MECHANICAL PROPERTIES (3) Experiments in fatigue, creep, impact, and combined stresses; true stress-strain diagrams. *Professor Hu*

540. MECHANICS OF CONTINUA (3) Unified mathematical treatment of elements of fluid mechanics and of elasticity and plasticity of solids. Prerequisite: Math. 84 or 431.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400, 400X. ADVANCED STRENGTH OF MATERIALS (3) *Professor Hardenbergh*

401, 401X. ELEMENTS OF VIBRATIONS (3) *Professor Vierck*

402, 402X. APPLIED AND EXPERIMENTAL STRESS ANALYSIS (3) *Professors Marin and Hu*

403, 403X. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) *Professor Marin*

404, 404X. RESEARCH IN ENGINEERING MECHANICS (1-6)

406. ENGINEERING APPLICATIONS OF FLUID MECHANICS (3) *Professor Ranz*

ENGLISH

PROFESSOR THEODORE J. GATES, M.A.

Head of the Department of English Composition

PROFESSOR BRICE HARRIS, M.A., Ph.D.

Head of the Department of English Literature

501. MATERIALS AND METHODS OF RESEARCH (3) Bibliography of literary history and criticism; methods of editing and annotating texts; form and materials of dissertations. Required of all graduate students with an English major. *Professor Ridenour*
502. ANCIENT AND MEDIEVAL RHETORIC AND POETIC (3) Rhetorical and poetic doctrine of ancient and medieval times. *Professor Reed*
507. RESEARCH PROBLEMS IN ENGLISH (1-6) Methods of research in English, problems of bibliography, and method of evaluating sources and materials.
508. BEOWULF (3) Reading of the text and study of the prominent literary problems and relationships. *Professor Mead*
509. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE PROSE WRITERS (3) *Professor Mead*
510. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE POETS (3) *Professor Locklin*
514. SHAKESPEARE (3) Special problems in the works of Shakespeare. *Professor Bowman*
515. THE AGE OF SWIFT (3) Special studies varying from year to year. *Professor Harris*
516. THE AGE OF JOHNSON (3) The work of Johnson and his circle. *Professor Mead*
517. BYRON, SHELLEY, AND KEATS (3) *Professor Ridenour*
518. PRE-ROMANTIC WRITERS (3) Development of Romantic ideas in the 18th century. *Professor Ridenour*
519. WORDSWORTH, COLERIDGE, SOUTHEY, AND SCOTT (3) *Professor Ridenour*
530. HISTORY OF THE ENGLISH LANGUAGE (3) Germanic background of English, phonological and morphological developments, dialect differentiations, and principles of linguistic change. *Professor Mead*
531. OLD ENGLISH (3) Old English language and literature with lectures on Old English and Germanic philology. *Professor Mead*
532. MIDDLE ENGLISH (3) Middle English language and literature with lectures on the development of Old English through Middle English to modern times. *Professor Mead*

534. HISTORICAL ENGLISH GRAMMAR (3) Evolution of the grammatical system of English. *Professor Peck*
535. RENAISSANCE AND MODERN RHETORIC (3) The rhetorical and poetic doctrine of Renaissance and modern times. *Professor Rubin*
540. CHAUCER (3) Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences. *Professor Mead*
542. PROSE STYLE (3) Development of English prose style. *Professor Major*
543. CAVALIER AND ANGLICAN (3) Poetry and prose of the middle years of the 17th century from the death of Shakespeare to 1660. *Professor Mead*
544. RESTORATION LITERATURE (3) Selected studies of writers in England between 1650 and 1700. *Professor Harris*
545. POETS OF THE VICTORIAN PERIOD, EXCLUSIVE OF TENNYSON AND BROWNING (3) *Professor Long*
546. TENNYSON AND BROWNING (3) *Professor Long*
547. PROSE WRITERS OF THE VICTORIAN PERIOD (3) *Professor Long*
550. SELECTED STUDIES IN THE BRITISH NOVEL TO 1840 (3) *Professor Bowman*
551. SELECTED STUDIES IN THE BRITISH NOVEL FROM 1840 TO THE PRESENT (3) *Professor Sutherland*
562. THE AMERICAN NOVEL (3) *Professor Werner*
563. AMERICAN ESSAYS (3) Lectures and reports on a special group of essayists. *Professor Werner*
565. THE AMERICAN SHORT STORY (3) *Professor Werner*
566. AMERICAN POETRY (3) *Professor Werner*
567. ANGLO-AMERICAN FOLK SONG (3) Oral tradition of melodies and texts; types, regions, theories. *Professor Bayard*

ENGLISH COMPOSITION

PROFESSOR THEODORE J. GATES, M.A.

Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

404. PUBLIC OPINION AND WRITTEN PERSUASION (3) *Professor Graves*
418. THE WRITING OF LITERARY CRITICISM (3) *Professor Rubin*
442. CONTEMPORARY PROSE STYLE (3) *Professor Major*

ENGLISH LITERATURE

ENGLISH LITERATURE

PROFESSOR BRICE HARRIS, M.A., Ph.D.

Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

400. TEACHERS' COURSE IN LITERATURE (3)
401. MAIN CURRENTS IN AMERICAN LITERATURE (3) *Professor Merrill*
423. FORMS AND MOVEMENTS OF BRITISH LITERATURE (3) *Professor Ridenour*
439a,b,cS. OUR CONTEMPORARIES (3)
440a,b,cS. MASTERS OF LITERATURE (1-3)
441a,b,cS. MASTERS OF ENGLISH LITERATURE (1-3)
460. LITERARY BIOGRAPHY (3) *Professor Merrill*
464. SPENSER (3) *Professor Locklin*
466. MILTON (3)
480. THE DRAMA BEFORE SHAKESPEARE (3)
481. JACOBEOAN AND CAROLINE DRAMA (3)
484. AMERICAN DRAMA (3)
485. SCANDINAVIAN DRAMA (3)
486. LATER BRITISH AND IRISH DRAMATISTS (3)
487. MODERN CONTINENTAL DRAMA (3)
488. THE DRAMA FROM DRYDEN TO SHERIDAN (3)

ENTOMOLOGY

PROFESSOR BERTIL G. ANDERSON, M.S., Ph.D.

Head of the Department of Zoology and Entomology

505. ADVANCED MORPHOLOGY OF INSECTS (3) Advanced work in either external or internal morphology of insects. Prerequisites: Ent. 403, 405. *Professor Rutschky*
506. IMMATURE INSECTS (3) The morphology and taxonomy of the immature stages of insects. Prerequisite: 9 credits in entomology. *Professor Blackburn*
508. THE BIOLOGICAL CONTROL OF INSECTS (2) Artificial use of bacteria, fungous diseases, and animals in control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 6, 8, 407. *Professor Frost*
509. ENTOMOLOGICAL TECHNIQUE (2) For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 6. *Professor Frost*

514. ADVANCED SYSTEMATIC ENTOMOLOGY (1-15 per semester) Taxonomy of various orders of insects selected to meet the needs of the individual student. Prerequisites: Ent. 403, 405. *Professor Rutschky*
528. INSECT PHYSIOLOGY (3) Normal functions of the insect body. Prerequisites: Ent. 405, A.B.Ch. 1.
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
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| 401. MEDICAL AND VETERINARY ENTOMOLOGY (3) | <i>Professor Frings</i> |
| 403. SYSTEMATIC ENTOMOLOGY (3) | <i>Professor Rutschky</i> |
| 405. INSECT MORPHOLOGY (3) | <i>Professor Rutschky</i> |
| 407. INSECT ECOLOGY (3) | <i>Professor Frost</i> |
| 413. ENTOMOLOGY SEMINAR (1 per semester) | <i>Professor Frost</i> |
| 429. PRINCIPLES OF INSECT CONTROL (3) | <i>Professor Blackburn</i> |
| 430. INSECT HISTOLOGY (2) | <i>Professor Rutschky</i> |
| 431. ENTOMOLOGICAL PROBLEMS (1-6) | |
| 445S. THE IDENTIFICATION OF INSECTS (3) | <i>Professor Frost</i> |

FOODS, NUTRITION, AND HEALTH

PROFESSOR MIRIAM E. LOWENBERG, M.S., Ph.D.

Head of the Department

520. READINGS IN FOODS (2) Critical review and reports of literature on selected food topics. *Professor Hester*
521. SEMINAR IN FOODS (1-6) Discussion and reports on current research in the foods field. Prerequisite or concurrent: Fd.Ntr. 520. *Professor Hester*
522. ADVANCED EXPERIMENTAL FOODS (3) Experimental methods used in measuring the quality of foods; specific problems in food preparation. *Professor Hester*
530. PROBLEMS IN FOODS AND NUTRITION (1-6)
550. READINGS IN NUTRITION (3) Readings and reports of selected topics in nutrition. Prerequisite: Fd.Ntr. 450. *Professor Padgett*
551. SEMINAR IN NUTRITION (1-6) Selected topics and recent advances in nutrition.
552. DIET IN DISEASES (3) Physiological and biochemical problems in metabolic diseases and the nutritional aspects of therapy. *Professor Pike*
553. NUTRITION OF CHILDREN (3) Nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: A.B.Ch. 35, Fd.Ntr. 450. *Professor Padgett*
555. FIELD WORK IN NUTRITION (2-4) Field problems planned to meet the needs of individual students. Hours and problems to be arranged.

FOODS AND NUTRITION

556. THE SURVEY METHOD IN FOODS AND NUTRITION (2) Study of survey technique as a tool in the assay of food adequacy and nutritional status.
Professor Dodds

557. INTERRELATIONSHIPS OF NUTRIENTS (2) Interrelationships of nutrients in the metabolic processes; their significance as applied to nutrition.
Professor Pike

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. SPECIAL PROBLEMS IN FOODS AND NUTRITION (1-3)
420. EXPERIMENTAL COOKERY (1-6) *Professor Olson*
421. ADVANCED FOODS (3)
423, 423X. (H.Mgmt. 423). FAMILY FOOD PURCHASING (2)
425. FOOD PRESERVATION (2) *Professor Hester*
426S. RECENT DEVELOPMENTS IN FOODS (3)
450. NUTRITION (4) *Professor Padgett*
451. RECENT DEVELOPMENTS IN NUTRITION (3)
452. ELEMENTS OF DIET IN DISEASE (3) *Professor Pike*
455, 455X. TEACHING NUTRITION TO BOYS AND GIRLS (3)
456. NUTRITION IN THE COMMUNITY (3) *Professor Lowenberg*
491, 491v. TEACHING HOME NURSING (1)

FORESTRY

PROFESSOR MAURICE K. GODDARD, M.S.

Director of the School of Forestry

502. WOOD FIBERS (3-5) Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulping quality, fiber measurements. *Professor White*
504. RESEARCH METHODS IN FORESTRY (2-6 per semester) Review of methods employed in conducting forestry research. *Professor Bramble*
508. FOREST ECOLOGY (2-4) Organization, development, and classification of forest communities. *Professor Bramble*
509. COVERT MANAGEMENT (2) Management of forest associations for maintenance and development of wildlife. Prerequisite: For. 508. *Professor Bramble*
510. SEMINAR (1-2 per semester) Current problems of forest research presented as weekly seminar reports. May be repeated with additional credit for each semester's work. *Professor Bramble*
530. RESEARCH IN WOOD UTILIZATION (3-6 per semester) Research in some phase of wood utilization of forest products. Prerequisite: For. 431. *Professor Norton*
531. STRUCTURAL USES OF WOOD AND WOOD PRODUCTS (3-6 per semester) Wood as a construction material; testing techniques for structural timbers

and wood assemblies; use of laminated wood, ring connectors, and other types of special construction. Prerequisite: For. 404. *Professor Norton*

532. LAMINATES (3-6 per semester) Advanced and special studies in fabrication and use of plywood, laminated wood, paper-base laminates, and wood-to-metal bonding. Prerequisite: For. 405. *Professor Norton*

535. CONDITIONING TREATMENTS FOR WOOD (3-6 per semester) Advanced study and problems in preservative, seasoning, and other special treatments for wood and wood products. Prerequisite: For. 435. *Professor Norton*

550. FOREST MENSURATION (2-8 per semester) Research in some chosen field. Prerequisite: For. 450. *Professor Meyer*

560. FOREST MANAGEMENT (3-8) Special topics in forest management and research in some chosen field. Prerequisite: For. 466. *Professor Meyer*

575. APPLICATIONS OF FOREST ECONOMICS AND FINANCE (3 per semester) Survey of situations in forestry where business problems and particular circumstances of production, value, and costs are currently significant. Prerequisite: For. 70. *Professor Humphrey*

590. THE LUMBER INDUSTRY (2-4) Relation of the lumber industry to national economy and world trade; lumbermen's associations; lumber accounts.

591. PROBLEMS IN LUMBERING (2-6) Research in some chosen phase of lumbering. Prerequisite or concurrent: For. 590.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

404. MECHANICAL PROPERTIES OF WOOD (3) *Professor Nearn*

405. VENEER AND PLYWOOD (3) *Professors Norton and Nearn*

421. REGIONAL SILVICULTURE (4) *Professor Cope*

427. FOREST RANGE MANAGEMENT (3) *Professor Chisman*

431. PROBLEMS IN WOOD UTILIZATION (3-6) *Professors Norton and Nearn*

435. SEASONING AND PRESERVATION (3) *Professor Nearn*

437. ADVANCED WOOD TECHNOLOGY (3) *Professors White and Jorgensen*

445. IMPROVEMENTS (3) *Professor Worley*

450. ADVANCED MENSURATION (2) *Professor Meyer*

455. AERIAL PHOTOGRAMMETRY IN FOREST MANAGEMENT (2) *Professor Worley*

462. DEFECTS IN WOOD (3) *Professor Norton*

466. FOREST MANAGEMENT AND MANAGEMENT PLANS (4) *Professor Meyer*

468. SILVICULTURAL RESEARCH (3-6) *Professor Chisman*

469. PROBLEMS IN FOREST MANAGEMENT (3) *Professor Meyer*

475. PROBLEMS IN FOREST ECONOMICS AND FINANCE (3) *Professor Humphrey*

480. POLICY AND ADMINISTRATION (3)

491. LUMBERING (3) *Professor Schmidt*

492. LUMBER DISTRIBUTION (3) *Professor Schmidt*

495. MILLING AND COSTS IN LUMBER INDUSTRY (3) *Professor Schmidt*

497. SMALL SAWMILLS (3) *Professor Schmidt*

FRENCH

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Head of the Department of Romance Languages

- *1G. ELEMENTARY FRENCH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.
- 501. FRENCH DRAMA OF THE CLASSICAL PERIOD (3) Origins and development of French classical comedy and tragedy, emphasizing the works of Corneille, Racine, and Molière.
- 544. NEOCLASSICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Neoclassic movement in Italy, France, Spain, and Portugal. Prerequisite: Fr. 40.
- 545. ROMANTICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Romantic movement in Italy, France, Spain, and Portugal.
- 546. MEDIEVAL ROMANCE LITERATURES (3) Nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal.
- 547. REALISM, WITH PARTICULAR REFERENCE TO ROMANCE LITERATURES (3)
- 549. SYMBOLISM (3) The anti-positivistic tradition in 19th century French literature dealing with the Symbolist School, its antecedents and its subsequent ramifications.
- 551. ROMANCE PHILOLOGY (3) Historical development of the Romance languages.
- 552. MEDIEVAL FRENCH LITERATURE (3) Familiarizes the student with Old and Middle French texts from the earliest monuments to Villon. Prerequisite: Fr. 551.
- 553. FRENCH LITERATURE OF THE RENAISSANCE (3) The French Renaissance from 1498 to 1548.
- 554. THE RENAISSANCE IN THE ROMANCE LITERATURES (3) Themes and forms of literature in the humanistic period.
- 562. FRENCH THINKERS OF THE 18TH CENTURY (3)
- 564. FRENCH ROMANTICISM (3) The French Romantic movement after 1830.
- 570. VOLTAIRE AND ROUSSEAU (3)
- 571. SEMINAR IN FRENCH LITERATURE (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

*No graduate credit is given for this course.

572. SEMINAR IN FRENCH LITERATURE (3) Continuation of Fr. 571.
 574. METHODS AND BIBLIOGRAPHY IN ROMANCE LANGUAGES AND LITERATURES (1-2)
 580. PROUST AND GIDE (3)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. FRENCH LITERATURE OF THE RENAISSANCE (3)
 405. FRENCH LITERATURE IN THE ROMANTIC PERIOD (3)
 406. FRENCH LITERATURE IN THE REALISTIC PERIOD (3)
 411. FRENCH PROSE OF THE 20TH CENTURY (3)
 413, 413X. CONTEMPORARY FRENCH DRAMA (3)
 416. FRENCH POETRY AND DRAMA OF THE 20TH CENTURY (3)
 421. THE TEACHING OF ROMANCE LANGUAGES (3)
 431. FRENCH LITERATURE OF THE CLASSICAL PERIOD (3)
 433. THE AGE OF ENLIGHTENMENT (3)
 437. THE FRENCH ANALYTICAL NOVEL (3)
 471. PROBLEMS IN FRENCH LITERATURE (3-6)
 490. ADVANCED COMPOSITION AND CONVERSATION (3)
 496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

FUEL TECHNOLOGY

PROFESSOR PHILIP L. WALKER, JR., M.S., Ph.D.

Head of the Department

502. RESEARCH DATA (3) Designed for the graduate student beginning laboratory research; methods of obtaining and interpreting research data.
 Prerequisite: Math. 30. *Professor Nielsen*
 503. CHEMICAL CONSTITUTION AND SCIENTIFIC CLASSIFICATION OF COAL (3-6) Chemistry of plant constituents in relation to coal and the coalification process; constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. *Professor Kinney*
 505. PHYSICOCHEMICAL PROPERTIES OF COAL, MINERAL MATTER, AND ASH (3) Physical, physicochemical, and use properties; their significance and applications. Prerequisite: Chem. 461.
 506. ADVANCED COMBUSTION (3) Advanced combustion and heat balance calculations, ignition and flame characteristics of fuels; furnace atmospheres; selection of fuels with reference to use and equipment. Prerequisite: Chem. 461. *Professor Walker*
 507. ADVANCED THERMAL PROCESSING (3) Pyrolysis, coal carbonization, coke manufacture and uses; action of heat on coals and fuels; technical and economic factors. Prerequisites: Chem. 35, 461, or Min.Pr. 410. *Professor Polansky*

FUEL TECHNOLOGY

508. SYNTHESIS OF LIQUID FUELS (3) Chemical nature of liquid hydrocarbons; preparation of hydrogen and synthesis gas; theoretical and practical aspects of synthetic liquid fuel processes. Prerequisites: Chem. 31, Fuel T. 402. *Professor Kinney*
509. TECHNOLOGY OF TARs (3) Formation, constitution, physical and chemical properties of coal, oil-gas and water-gas tar; processing and utilization. Prerequisite: Chem. 31. *Professor Polansky*
510. FUEL TECHNOLOGY PROBLEM (1-6 per semester) Special problems in fuel technology. Prerequisite: Fuel T. 503.
511. FUEL TECHNOLOGY SEMINAR (1-6) Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 461. *Professor Kinney and Staff*

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in fuel technology studies are listed under Mineral Sciences.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. FUEL TECHNOLOGY RESEARCH AND DESIGN (1-3)
401. FUEL GASES AND GASIFICATION (3)
402. CHEMICAL PROCESSING OF FUELS (2) *Professor Kinney*
403. ENERGETICS OF FUEL TECHNOLOGY (3)
404. FUEL TECHNOLOGY DESIGN (3) *Professor Spicer*

GENERAL HOME ECONOMICS

PROFESSOR DOROTHY HOUGHTON, M.S., Ph.D.

Assistant Dean of the College of Home Economics

- 516, 516v. METHODS OF RESEARCH IN HOME ECONOMICS (3) Review of problems and techniques of research in home economics. Required of all graduate students in home economics. *Professor Hatcher*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

- 400, 400v, 400X, 400vX. RECENT FINDINGS IN HOME ECONOMICS (2-3)

GEOGRAPHY

PROFESSOR E. WILLARD MILLER, M.A., Ph.D.

Head of the Department

503. ADVANCED REGIONAL GEOGRAPHY (3-12) Intensive study at an advanced level of selected regions or sections of the continents. Prerequisite: 12 credits in geography. *Professors Miller and Deasy*

504. PHYSICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professors Miller and Deasy*
505. ECONOMIC GEOGRAPHY SEMINAR (3-12) The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Miller*
506. CULTURAL AND POLITICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions. *Professor Griess*
510. PHYSICAL GEOGRAPHY RESEARCH (3-10) Original study in physical geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Deasy*
511. ECONOMIC GEOGRAPHY RESEARCH (3-10) Original study in economic geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Miller*
512. CULTURAL AND POLITICAL GEOGRAPHY RESEARCH (3-10) Original study in cultural and political geography: a field problem or detailed library investigation with analysis and presentation of data. *Professor Griess*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. REGIONAL GEOGRAPHY OF NORTH AMERICA (3) *Professor Deasy*
401. REGIONAL GEOGRAPHY OF PENNSYLVANIA (3) *Professor Miller*
403. REGIONAL GEOGRAPHY OF SOUTH AMERICA (3) *Professor Griess*
405. CULTURAL GEOGRAPHY (3) *Professor Griess*
420. URBAN GEOGRAPHY (3)
- 427S. REGIONAL GEOGRAPHY OF THE SOVIET UNION (3)
433. REGIONAL CLIMATOLOGY (3) *Professor Deasy*
435. FIELD METHODS IN GEOGRAPHY (3) *Professor Miller*
442. GEOGRAPHY OF EUROPE (3) *Professor Miller*
443. GEOGRAPHY OF THE ORIENT (3) *Professor Rodgers*
444. GEOGRAPHY OF AFRICA (3) *Professor Griess*
452. INTERPRETATION OF AERIAL PHOTOGRAPHS (3) *Professor Deasy*
460. POLITICAL GEOGRAPHY (3) *Professor Griess*
480. GEOGRAPHY OF WORLD MANUFACTURING (3) *Professor Miller*

GEOLOGY

PROFESSOR FRANK M. SWARTZ, Ph.D.

Head of the Department

- *500. GEOLOGY SEMINAR (1-9) Presentation, at weekly departmental meetings, of topics selected from geological literature.

*Credits to be arranged, 1 to 6 per semester.

GEOLOGY

- †501. STRATIGRAPHY (3-12) Principles of stratigraphic classification, lithofacies and biofacies, faunal zonation, correlation, sedimentation, and paleogeography, illustrated by stratigraphy of classical geologic regions: (a) Pre-Cambrian; (b) Paleozoic; (c) Mesozoic; (d) Cenozoic. Prerequisite: Geol. 464. *Professor Swartz*
- †503. PALEONTOLOGY (3-9) Morphology of animal groups significant for their fossils; nature of species and faunal zones. Seminars may be arranged for studies of special fossil groups, microfossils, paleoecology. *Professor Swartz*
504. HISTORY OF GEOLOGY (2-3) Development through the ages of the scientific method in earth sciences. *Professor Krynine*
507. SEMINAR IN GEOMORPHOLOGY (3-6) Classic and current literature in geomorphology.
511. ORE DEPOSITS: PRINCIPLES (3-6) Geological and geochemical processes controlling ore deposition; genetic classification of ore deposits. Prerequisite: Geol. 451. *Professor Ridge*
512. ORE DEPOSITS: TYPES (1-6) Geologic history and field examination of selected ore bodies; forming media; causes, sequences, and loci of emplacement; wall rock alteration; secondary enrichment. Prerequisite: Geol. 511. *Professor Ridge*
515. ORE MICROSCOPY (2-3) Theory and use of the ore microscope in identifying ore minerals in polished section, establishing paragenetic sequences, determining manner of deposition. *Professor Ridge*
520. SEMINAR IN PALEOBOTANY (2-6) Current and classic literature concerning evolution, paleoecology, and geologic history of vascular plants. *Professor Spackman*
524. COAL PETROLOGY (1-6) Microscopy, source materials, coalification, constitution, classification of peats, lignites, bituminous coal, anthracite. *Professor Spackman*
530. GEOLOGICAL PROBLEMS (3-6) Study, from the literature, of a selected geological problem. Prerequisite: 10 credits of geology and mineralogy.
545. GLACIAL GEOLOGY (3) Glaciers: their characteristics, causes, deposits, land forms, effects in periglacial regions.
551. GEOTECTONICS (3-6) Tectonic principles and elements: nature and development of geosynclines, island arcs, mountain structures, stable masses, cratons, mobile belts. *Professor Scholten*
571. PETROLEUM PROVINCES OF THE WORLD (3) Stratigraphy, structure, geologic history, and oil and gas occurrence in major petroliferous provinces. *Professor Scholten*

†Credits to be arranged, 3 to 6 per semester.

590. GEOLOGY FIELD TRIP (1 per year) Field study of regional geologic features with trips in successive years to differing geologic provinces. Required each spring of all graduate students in geology.

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in geological studies are listed under Mineral Sciences.*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 420. PALEOBOTANY (3) | Professor Spackman |
| 424. GEOLOGY OF COAL (2) | Professor Nickelsen |
| 451. ECONOMIC GEOLOGY (3) | Professor Scholten |
| 455. PHYSIOGRAPHY OF NORTH AMERICA (3) | Professor Dort |
| 461. GEOLOGY OF THE UNITED STATES (3) | |
| 462. PRINCIPLES OF GEOMORPHOLOGY (3-6) | |
| 464. PALEONTOLOGY (3) | Professor Swartz |
| 481. GEOLOGY OF OIL AND GAS (3) | Professor Scholten |
| 482. METALLIC MINERAL DEPOSITS (3) | Professor Ridge |
| 483. STRUCTURAL GEOLOGY (3) | Professor Nickelsen |
| 484. PALEOZOIC STRATIGRAPHY (3) | Professor Swartz |
| 485. PALEONTOLOGY (2) | Professor Swartz |
| 486. STRATIGRAPHIC METHODS (1) | Professor Swartz |
| 488. EARTH SCIENCES SEMINAR (1) | |
| 489. EARTH SCIENCES REPORT (1) | |

G E O P H Y S I C S A N D G E O C H E M I S T R Y

PROFESSOR B. F. HOWELL, JR., M.S., Ph.D., P.E.

Head of the Department

500. GEOPHYSICAL SEMINAR (1 per semester) Discussion of geophysical reports and papers; scientific outlook. Prerequisites: G.G. 401, 402.
Professor Howell
501. RESEARCH (1-15 per semester) Original research in geophysics or geochemistry.
502. SEISMIC INSTRUMENTS (2) Characteristics and design of seismometers and seismic recorders. Prerequisite: Phys. 285, differential equations. Given alternate years.
Professor Howell
503. SPECIAL STUDIES IN GEOPHYSICS (1-9) Special studies of the theories of geophysical methods. Prerequisite: 6 credits in geophysics.
507. SEISMOLOGY (3) Nature and transmission of seismic waves; cause and occurrence of earthquakes; applications in seismic prospecting. Prerequisites: Math. 431, Phys. 285.
Professor Howell
508. TECTONICS (3) Seminar in the cause and nature of the principal deformations of the earth. Prerequisite: Geol. 483.
Professor Howell

G E O P H Y S I C S A N D G E O C H E M I S T R Y

509. GEOCHEMISTRY SEMINAR (1 per semester) Prerequisite: G.G. 406.
Professor Keith
510. PROBLEMS IN GEOCHEMISTRY (1-9) Laboratory and library study of special problems. Prerequisite: G.G. 406.
511. STRUCTURE AND PROPERTIES OF MINERAL MATTER (2-6)
512. PRINCIPLES AND METHODS IN HIGH-TEMPERATURE GEOCHEMISTRY (3) Ion configuration and radii; simple crystal structures; measurement and control of temperature and pressure; methods of phase equilibrium determination.
Professor Roy
513. PHASE EQUILIBRIA IN MINERAL SYSTEMS (3-6) Phase relations and constitution of inorganic crystals and liquids; special emphasis on systems closely related to natural magmas and rock systems. Prerequisite: G.G. 512.
Professor Osborn
514. ELEMENT DISTRIBUTION IN THE EARTH (3) Principles and data from studies of phase equilibria, petrology, and crystal structure as related to distribution of elements in minerals, rocks, and the earth. Prerequisite: G.G. 513.
Professor Keith

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in geophysical and geochemical studies are listed under Mineral Sciences.*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. ELECTRICAL PROSPECTING (3) *Professor Moore*
402. SEISMIC PROSPECTING (3) *Professor Howell*
403. GEOPHYSICS FIELD WORK (1-3) Summer practicum.
404. MINING GEOPHYSICS LABORATORY (1) *Professor Moore*
405. INTRODUCTORY GEOPHYSICS (3) *Professor Howell*
406. INTRODUCTORY GEOCHEMISTRY (3) *Professor Keith*
407. WELL LOGGING (2) *Professor Moore*
408. POTENTIAL THEORY APPLIED TO EARTH PROBLEMS (3) *Professor Hipple*
409. GEOPHYSICAL PROSPECTING (3) *Professor Moore*

GERMAN

PROFESSOR PHILIP A. SHELLEY, A.M., Ph.D.

Head of the Department

- *1G. ELEMENTARY GERMAN FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.
501. GERMAN LANGUAGE SEMINAR (3-9) Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.

*No graduate credit is given for this course.

515. GERMAN LITERATURE SEMINAR (3-9) Special aspects and characteristics of individual writers and various types and periods of literature.
524. INTENSIVE STUDY OF THE LIFE AND WORKS OF GOETHE (3) Various phases of the poet's life and individual works. *Professor Buffington*
531. SPECIAL STUDIES IN THE GERMAN LYRIC (3) *Professor Shelley*
532. SPECIAL STUDIES IN THE GERMAN DRAMA (3) *Professor Adolf*
533. SPECIAL STUDIES IN THE GERMAN SHORT STORY (3) *Professor Steiner*
534. SPECIAL STUDIES IN THE GERMAN NOVEL (3) *Professor Adolf*
551. MIDDLE HIGH GERMAN (3) Extensive reading of texts; characteristics of the various dialects. *Professor Buffington*
552. OLD HIGH GERMAN (3) Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A.D. Papers. *Professor Buffington*
553. GOTHIC (3) Essentials of the grammar; reading of Ulfilas' Bible translation. Suitable also for advanced students in English. Papers. *Professor Adolf*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. PROSEMINAR IN BIBLIOGRAPHY AND METHODS OF RESEARCH (2) *Professor Shelley*
401. HISTORY OF THE GERMAN LANGUAGE (3) *Professor Buffington*
421. GERMAN LITERATURE IN THE 18TH CENTURY (3) *Professor Buffington*
422. GERMAN LITERATURE IN THE 19TH CENTURY (3) *Professor Adolf*
423. GERMAN LITERATURE OF THE 20TH CENTURY (3) *Professor Steiner*
443. (C.Lit. 443). LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9) *Professor Shelley*

GREEK

PROFESSOR ROBERT E. DENGLE, A.M., Ph.D.

Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following 400 and 500 courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

500. GREEK COMPOSITION (2) Translation of extended narrative passages into Attic Greek; thorough review of forms and syntax; attention to rhetorical elements of the language. *Professor Dengler*

G R E E K

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

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| 411S. ESSENTIALS OF GREEK (3) | |
| 421. GREEK TRAGEDY (3) | <i>Professor Dengler</i> |
| 422. GREEK COMEDY (3) | <i>Professor Dengler</i> |
| 423. ATTIC ORATORS (3) | <i>Professor Dengler</i> |
| 424. GREEK HISTORY OR PHILOSOPHY (3) | <i>Professor Dengler</i> |
| 427. NEW TESTAMENT GREEK (3) | <i>Professor Dengler</i> |

HEALTH EDUCATION

Consult PROFESSOR ARTHUR L. HARNETT, JR., M.A., Ed.D.

501. HEALTH IMPLICATIONS IN THE GROWTH AND DEVELOPMENT OF SCHOOL CHILDREN (3) Child growth and development emphasis for teachers; medical inspection and examination; preschool program; early habit formations; behavior problems; co-operation of parents, teachers, and children. Prerequisite: Hl.Ed. 215. *Professor Davis*
505. ADVANCED TECHNIQUES IN HEALTH EDUCATION (3) Prerequisites: Hl.Ed. 215, 399, Psy. 437. *Professor Harnett*
572. TESTS AND MEASUREMENTS IN HEALTH EDUCATION (3) Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Ph.Ed. 490, Hl.Ed. 215, 399.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

403. FIRST AID, ATHLETIC CONDITIONING AND TRAINING (3) *Mr. Medlar*
405. RECENT DEVELOPMENTS IN PUBLIC HEALTH EDUCATION (3-6) *Professor Davis*
406. RECENT DEVELOPMENTS IN SCHOOL HEALTH EDUCATION (3) *Professor Harnett*
- 407, 407X. ADVANCED PERSONAL AND PUBLIC HEALTH (3) *Professor Harnett*
- 411, 411X. PRINCIPLES AND METHODS OF TEACHING SAFETY EDUCATION (3) *Professor Davis*
427. HEALTH FACTORS IN THE DEVELOPMENT OF THE ADOLESCENT (3) *Professor Davis*
- 453, 453X. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION (3) *Professor Harnett*
- 455S. RELATIONSHIPS OF HEALTH EDUCATION TO THE EXACT SCIENCES (3) *Professor Harnett*
456. ADVANCED TECHNIQUES IN RURAL SCHOOL HEALTH (3) *Professor Harnett*
- 495S. (Ch.Fm. 495S, Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9) *Professor Davis*

HISTORY

PROFESSOR PHILIP S. KLEIN, M.A., Ph.D.

Head of the Department

501. EUROPEAN HISTORIOGRAPHY (3) *Professor Pundt*
502. AMERICAN HISTORIOGRAPHY (3) *Professor Klein*
504. MEDIEVAL CIVILIZATION (3-9) *Professor Dahmus*
505. THE AGE OF THE REFORMATION (3-6) *Dr. Green*
508. STUDIES IN EUROPEAN HISTORY, 1600-1789 (3-6) *Professor Pundt*
509. EUROPE SINCE 1789 (3-6) Prerequisites: Hist. 18, 19.
Professors Pundt and Forster
512. STUDIES IN PENNSYLVANIA HISTORY (3-6) *Professor Klein*
520. COLONIAL AND REVOLUTIONARY AMERICA (3-6) Prerequisites: Hist.
20, 21. *Professor Hermann*
533. THE UNITED STATES, 1783-1860 (3-6) *Professor Klein*
534. THE UNITED STATES, 1860-1900 (3-6) Prerequisites: Hist. 20, 21.
Professors Hermann and Brown
536. THE UNITED STATES IN THE 20TH CENTURY (3-6)
Professors McNall and Murray
538. DIPLOMATIC HISTORY OF THE UNITED STATES (3)
Professors Gray and DeNovo
540. STUDIES IN BRITISH HISTORY (3-6) *Professor Forster*
550. PROBLEMS IN HISTORY (3-6)
562. SEMINAR IN LATIN-AMERICAN HISTORY (3-6) Prerequisites: Hist.
22, 23. *Professor Gray*
563. STUDIES IN THE HISTORY OF THE CARIBBEAN AREA (3) Prerequi-
sites: Hist. 22, 23. *Professor Gray*
- In addition to these courses, the following may be taken for graduate credit
under the restrictions in force:*
- 405, 405X. HISTORICAL BACKGROUND OF AMERICAN POLITICAL PARTIES,
1607-1900 (3) *Professor Rayback*
406. HISTORY OF AMERICAN LABOR (3) *Professor Rayback*
407. THE DIPLOMATIC HISTORY OF THE UNITED STATES (3)
Professor DeNovo
418. RENAISSANCE AND REFORMATION (3) *Dr. Green*
- 419, 419X. RECENT EUROPEAN HISTORY (3) *Professor Forster*
- 421, 421X. RECENT AMERICAN HISTORY (3)
Professors McNall and Murray

HISTORY

423. THE FORMATIVE PERIOD OF AMERICAN HISTORY (3)
Professor Klein, Dr. Colbourn
429. INTELLECTUAL HISTORY OF THE MIDDLE AGES (2-3)
Professor Dahmus
437. THE MIDDLE AGES FROM CONSTANTINE TO THE CRUSADES (3)
Professor Dahmus
438. THE MIDDLE AGES FROM THE CRUSADES TO THE RENAISSANCE (3)
Professor Dahmus
440. HISTORY OF ENGLAND AND GREAT BRITAIN SINCE 1485 (3)
Professor Forster
441. RECENT HISTORY OF GREAT BRITAIN (3)
Professor Forster
443. HISTORY OF MODERN RUSSIA (3)
Dr. Thaden
444. EASTERN EUROPE IN MODERN TIMES (3)
Dr. Thaden
447. ECONOMIC DEVELOPMENT OF MODERN EUROPE SINCE 1750 (3)
Professor Pundt
448. SOCIAL AND CULTURAL HISTORY OF MODERN EUROPE (3)
Professor Pundt
450. ECONOMIC DEVELOPMENT OF COLONIAL AMERICA, 1607-1783 (3)
 To alternate with Hist. 451. *Professor Hermann*
451. SOCIAL AND CULTURAL HISTORY OF COLONIAL AMERICA, 1607-1783
 (3) To alternate with Hist. 450. *Professor Hermann*
452. SOCIAL AND CULTURAL HISTORY OF THE UNITED STATES SINCE 1783
 (3) *Professor Brown*
453. AMERICAN POLITICAL BIOGRAPHY (3) *Professor Hermann*
454. THE ECONOMIC DEVELOPMENT OF THE UNITED STATES IN THE 19TH
 CENTURY (3) *Professor McNall*
460. LATIN AMERICA AND THE UNITED STATES (3) *Professor Gray*
461. SOCIAL AND CULTURAL HISTORY OF LATIN AMERICA (3) To alternate
 with Hist. 460. *Professor Gray*
- 499X. FOREIGN STUDY IN HISTORY (2-6)

HOME ART

PROFESSOR CHRISTINE F. SALMON, B.Arch., M.Arch.

Chairman of the Division

515. BACKGROUNDS OF THE HOME ARTS (3) Evaluation of useful objects
 in respect to their form, function, and time; selections for exhibition. Pre-
 requisites: H.Art 216 or Art 54 or Art Ed. 6, and Art 74 or H.Art 240.
541. ART IN THE ENVIRONMENT (3) Approach based upon human needs
 with consideration of materials in the light of their use in home living. Pre-
 requisite: Art 76 or Art Ed. 5 or H.Art 440.

*In addition to these courses, the following may be taken for graduate credit
 under the restrictions in force:*

400. SPECIAL PROBLEMS IN HOME FURNISHINGS (3)
- 433, 433X. ADVANCED HOME CRAFTS (2-12)
434. THE ART AND THE CRAFTS IN THE HOMEMAKING PROGRAM (3-6)
- 440, 440X. HOME FURNISHING PROBLEMS (3)

443. HOME ARTS IN THE ADULT PROGRAM (3)
 444, 444X. HOME FURNISHING TEACHING PROBLEMS (3)
 447, 447X. HOME FURNISHINGS FOR THE FAMILY (3)

HOME-COMMUNITY RELATIONSHIPS

PROFESSOR DOROTHY HOUGHTON, M.S., Ph.D.

Chairman of the Division

- 502, 502v, 502X, 502vX. HOME ECONOMICS AND AMERICAN SOCIETY (3)
 Family life education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.

503. GRADUATE SEMINAR IN HOME ECONOMICS (1) *Professor Henderson*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 499X. INTERCULTURAL STUDIES IN HOME ECONOMICS (2-6)

HOME ECONOMICS EDUCATION

PROFESSOR JEAN D. AMBERSON, M.A., Ph.D.

Head of the Department

- 502, 502v. HOME ECONOMICS INSTRUCTION AT THE COLLEGE LEVEL (3)
 Teaching techniques suitable for college instruction in home economics; for prospective home economics college teachers not majoring in home economics education.

- 503, 503v. PROBLEMS IN HOME ECONOMICS TEACHER EDUCATION (3)
 Organization of college programs of teacher education; use of resources; records; field services; recruitment and selection of personnel. Prerequisite: at least two years of experience in teaching home economics.

- 504, 504v. CURRENT DEVELOPMENTS IN EDUCATION IN RELATION TO HOME ECONOMICS (3) Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics. *Professor Amberson*

- 505, 505v, 505X, 505vX. PRACTICUM IN TEACHING HOME ECONOMICS IN THE SECONDARY SCHOOL (3-6) Projects in home economics education which may be carried out in the school in which the teacher is regularly employed. *Professor Hillier*

- 509, 509v, 509X, 509vX. CURRICULUM WORKSHOP IN FAMILY LIFE EDUCATION (3) Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics. *Professor Amberson, Hatcher, or Hillier*

HOME ECONOMICS EDUCATION

- 510, 510v, 510X, 510vX. THE SUPERVISION OF HOME ECONOMICS TEACHING (2-6) For teachers of home economics desiring to qualify as city, county, or student teacher supervisors. Prerequisite: graduation from a four-year teacher training curriculum and two years' teaching experience in home economics.
Professor Amberson or Hillier
- 518, 518v, 518X, 518vX. EVALUATION IN FAMILY LIFE EDUCATION (3) Methods of evaluating progress toward goals in home economics education and use of findings in program planning and revision.
Professor Amberson, Hatcher, or Hillier
- 521, 521v, 521X, 521vX. HOME ECONOMICS EDUCATION SEMINAR (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems.
Professor Amberson or Hatcher
- 526, 526v, 526X, 526vX. THE COMMUNITY PROGRAM IN FAMILY LIFE EDUCATION (2-3) Ways of discovering community needs and resources; methods in developing the community program in family living; leadership education for the lay member of the community.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 406, 406v, 406X, 406vX. TEACHING AIDS IN FAMILY LIFE EDUCATION (1-4)
- 427, 427v, 427X, 427vX. FAMILY LIFE EDUCATION (3)
- 443, 443v, 443X, 443vX. ADULT HOMEMAKING EDUCATION (3)
- 463, 463v. SENIOR SEMINAR (1)
- 466, 466v. STUDENT TEACHING (9)
- 478, 478v, 478X, 478vX. APPRAISING STUDENT PROGRESS IN EDUCATION FOR FAMILY LIVING (3)
- 479, 479v, 479X, 479vX. READINGS IN HOME ECONOMICS EDUCATION (1-4)

HOME MANAGEMENT AND FAMILY ECONOMICS

PROFESSOR DELPHA E. WIESENDANGER, M.S.

Head of the Department of Home Management, Housing, and Home Art

- 515, 515X. CONSUMER PROBLEMS (2-3) Methods of securing, evaluating, and presenting data concerning household commodities. For home economics teachers in high schools, colleges, and adult classes. Prerequisites: Fd.Ntr. 220, H.Mgmt. 442.
Professor Johnston
524. ECONOMIC PROBLEMS OF THE HOUSEHOLD (3) Economic problems of the present-day family; special emphasis on factors in household production, use of money income, and standards of living. Prerequisites: H.Mgmt. 439, Econ. 14.
Professor Johnston

HOME MANAGEMENT

528. HOME MANAGEMENT SUPERVISION (2-3) Evaluation of objectives and techniques in organization, supervision, and teaching of the home management house experience. Prerequisite: H.Mgmt. 439.
543. HOME MANAGEMENT IN RELATION TO FAMILY LIVING (3) Includes work with families in solution of their management problems. Prerequisites: Fd.Ntr. 220, H.Mgmt. 439. *Professor Wiesendanger*
544. SPECIAL PROBLEMS IN HOUSE MANAGEMENT (3) Specific management problems, such as social, financial, and material, including development of college level teaching aids. Prerequisites: 6 credits of home management or family economics courses in home economics. *Professor Wiesendanger*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 415, 415X. HOUSEHOLD BUYING PRACTICES (3) *Professor Johnston*
419, 419X. MANAGING FAMILY FINANCIAL RESOURCES (3) *Professor Honey*
- 423, 423X. (Fd.Ntr. 423). FAMILY FOOD PURCHASING (2)
424, 424X. ECONOMIC CONDITIONS IN RELATION TO THE FAMILY (3)
439, 439X. HOME MANAGEMENT (2) *Professors Frances Henderson and Muriel Starr*
442. RESIDENT EXPERIENCE IN HOME MANAGEMENT (3) Room and board will be charged at regular rates. *Professor Starr*
445. HOME MANAGEMENT EXPERIENCE (3) *Professor Starr*
477. FAMILY MANAGEMENT (3)

HORTICULTURE

PROFESSOR RUSSELL E. LARSON, M.S., Ph.D.

Head of the Department

500. ECOLOGY OF FRUIT PLANTS (3) Factors limiting the distribution and intensity of culture of fruit species and varieties and effect of environmental factors on cultural practices.
501. POMOLOGY RESEARCH (2-12) Investigation of problems involving review of literature, field and laboratory research. Prerequisite or concurrent: Hort. 445. *Professor White*
503. EXPERIMENTAL PLANT BREEDING (3-6) Problems based mainly on research work of the department, with review of experimental methods and literature. Prerequisite: Hort. 444. *Professor Larson*
504. VEGETABLE CROP RESEARCH (2-9) Investigation of problems involving review of literature, field and laboratory research. Prerequisite: Hort. 420 or 424. *Professor Odland*
505. PROBLEMS IN VEGETABLE PRODUCTION (2-6) Methods used in the more valuable contributions to vegetable production. Prerequisite: Hort. 420 or 424. *Professor Odland*

HORTICULTURE

506. NUTRITION OF HORTICULTURAL CROPS (2-4) Principles, applications, and interpretations of diagnostic methods for determining fertilizer requirements of horticultural crops. *Professor Smith*
507. PLANT BREEDING RESEARCH (3-6) Critical review of breeding projects of the department, with original investigations. Prerequisite: Hort. 444. *Professor Larson*
512. PRINCIPLES OF FRUIT AND VEGETABLE STORAGE (2-4) Principles involved in the maturation, storage, and senescence of fruits and vegetables, and their application. *Professor Ritter*
513. RESEARCH IN ORNAMENTAL HORTICULTURE (2-12) Review of research in ornamental horticulture, with original investigations. *Professor Meahl*
514. PROPAGATION OF ORNAMENTAL AND FRUIT PLANTS (3) Factors affecting the asexual and sexual propagation of fruit and ornamental plants. *Professor Meahl*
517. HORTICULTURE SEMINAR (1 per semester) Review of current research publications in horticulture. Each student presents one or more reviews of assigned topics.
518. RESEARCH PROBLEMS IN LANDSCAPE HORTICULTURE (2-12) Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. *Professor Bracken*
519. SEMINAR ON THE GENETICS OF HORTICULTURAL CROPS (1 per semester) Review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics.
520. SEMINAR ON THE BREEDING OF HORTICULTURAL CROPS (1 per semester) Each student presents one or more reviews of literature on assigned topics.
521. TECHNICAL PRACTICES IN LANDSCAPE CONTRACTING (2-12) Commercial and technical operations in landscape contracting and maintenance services. Prerequisites: Hort. 460, 461. *Professor Bracken*
523. PROPAGATION AND IMPROVEMENT OF VEGETABLE AND FLOWER CROPS (3) Methods and special techniques in breeding of flowers and vegetables; maintenance of seed stocks and seed production. Prerequisite: Hort. 444. *Professor Odland*
524. EXPERIMENTAL PROCEDURES IN HORTICULTURAL RESEARCH (3) *Professor Larson*
525. HORTICULTURAL RESEARCH TECHNIQUES (3) Practice in and comparison of methods and apparatus used in horticultural research. *Professor White*
526. RESEARCH IN FLORICULTURE (2-12) Greenhouse research and review of literature. Prerequisite or concurrent: Hort. 427, 428. *Professor Seeley*

HORTICULTURE

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 412. | STORAGE OF HORTICULTURAL CROPS (3) | Professor Ritter |
| 418. | SUBTROPICAL AND TROPICAL FRUITS (3) | Professor White |
| 420. | ADVANCED COMMERCIAL VEGETABLE PRODUCTION (3) | Professor Odland |
| 423. | ADVANCED FRUIT AND VEGETABLE PROCESSING (3) | Mr. Thomas |
| 424. | ADVANCED OLERICULTURE (3-6) | Professor Odland |
| 427. | ADVANCED FLORICULTURE (3) | Professor Seeley |
| 428. | ADVANCED FLORICULTURE (3) | Professor Seeley |
| 434. | RECREATION AREAS AND FACILITIES (4) | Professor Wilson |
| 444. | ADVANCED PLANT BREEDING (3-6) | Professor Walker |
| 445. | ADVANCED POMOLOGY (3) | Professor White |
| 446. | ADVANCED POMOLOGY (3) | Professor White |
| 447. | PROBLEMS IN POMOLOGY (1-6) | Professor White |
| 453. | NURSERY PRINCIPLES AND PRACTICE (3) | Professor Meahl |
| 454. | LANDSCAPE PROBLEMS (3-6) | Professor Bracken |
| 455. | LANDSCAPE PROBLEMS (3-6) | Professor Bracken |
| 456. | PROBLEMS IN NURSERY PRACTICE (3) | Professor Meahl |
| 460. | LANDSCAPE HORTICULTURE PROJECTS (3-6) | Professor Bracken |
| 461. | PARKS AND PARK ADMINISTRATION (3-6) | Professor Wilson |
| 462. | INSTITUTIONAL GROUNDS AND THEIR ADMINISTRATION (3-6) | Professor Wilson |
| 463. | LANDSCAPE HORTICULTURE PROJECTS (1-6) | Professor Bracken |

HOTEL ADMINISTRATION

PROFESSOR ESTHER A. ATKINSON, M.S.

Head of the Department of Hotel and Institution Administration

The following courses may be taken for graduate credit under the restrictions in force:

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| 440. | HOTEL OPERATIONAL LIABILITIES (2) | Professor Bower |
| 445. | HOTEL ORGANIZATION AND OPERATION (3) | Professor Bower |

HOUSING AND HOME EQUIPMENT

PROFESSOR DELPHA E. WIESENDANGER, M.S.

Head of the Department of Home Management, Housing, and Home Art

The following courses may be taken for graduate credit under the restrictions in force:

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| 413, 413X. | HOME EQUIPMENT (3) |
| 470, 470X. | HOUSING THE FAMILY (2-3) |

INDUSTRIAL ARTS

INDUSTRIAL ARTS

PROFESSOR S. LEWIS LAND, M.S., Ph.D.

Head of the Department of Industrial Education

PROFESSOR JOHN F. FRIESE, M.S.

574. HISTORY AND PHILOSOPHY OF INDUSTRIAL ARTS (2-3) Historical developments and concurrent educational philosophies of industrial arts in American education. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.
575. PROBLEMS IN INDUSTRIAL ARTS EDUCATION (2-3) Subject matter, projects, methods of manual and informational teaching, aids and devices, selection of text and reference materials, personnel organization, shop management, problem pupils. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.
576. SUPERVISION AND ADMINISTRATION OF INDUSTRIAL ARTS EDUCATION (2-3) How to organize, supervise, and administer functioning programs of industrial arts; duties of a supervisor and director of industrial arts. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.
577. TESTING IN INDUSTRIAL ARTS (2-3) Construction of informal manipulative and written tests; use of standardized mechanical aptitude and achievement tests; construction and use of rating scales; scoring and grading; interpretation of test results. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.
578. RESEARCH IN INDUSTRIAL ARTS (2-3) Research techniques in industrial arts education.
580. SEMINAR IN INDUSTRIAL ARTS (2-9) Directed intensive study, investigation, or research in selected phases of the program; reports and constructive criticism. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 400, 400X. SHOP MANAGEMENT AND LAYOUT (2-3)
407, 407X. INDUSTRIAL ARTS EDUCATION (2-3)
421, 421X. CURRICULUM MATERIALS IN INDUSTRIAL ARTS (2-3)
470, 470X. PROBLEMS IN SENIOR HIGH SCHOOL INDUSTRIAL ARTS (2-3)

INDUSTRIAL EDUCATION

PROFESSOR S. LEWIS LAND, M.S., Ph.D.

Head of the Department

- 501v. SEMINAR IN VOCATIONAL EDUCATION (1-12) Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators.

INDUSTRIAL EDUCATION

- 506v. ADMINISTRATION OF VOCATIONAL EDUCATION (1-6) The job of the local director of industrial education in organizing and developing city and other local programs of industrial education. Prerequisite: 6 credits in industrial education or valid director's certificate, equivalent training and experience.
- 510v. VOCATIONAL EDUCATION FOR ADMINISTRATORS (2-3) Designed for school administrators and supervisors who desire an understanding of practical arts and vocational education. Prerequisite: Ind.Ed. 1v or trade or teaching experience.
- 550v. RESEARCH IN VOCATIONAL EDUCATION (2-3) Research techniques in vocational industrial education.
- 555v. CURRENT PROBLEMS IN VOCATIONAL EDUCATION (1-6) Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome.
- Unit A. *Changing Industrial, Economic, and Social Conditions* (1)
 Unit B. *Policies and Program of the American Vocational Association* (1)
 Unit C. *Federal and State Vocational Legislation, Present and Pending* (1)
 Unit D. *Financing Vocational Education* (1)
 Unit E. *Current Administrative Problems in Vocational Education* (1)
 Unit F. *Current Administrative Problems in Vocational Education (cont'd)* (1)
- 558v. FRONTIER PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (2-3 per unit)
- Unit A. *Federal Legislation* (2-3)
 Unit B. *Present-Day Local Personnel and Curriculum Problems* (2-3)
 Unit C. *State and Local Supervision and Administration* (2-3)
- 560v. PHILOSOPHY OF INDUSTRIAL EDUCATION (2-3) Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices. Prerequisite: 12 credits in industrial education or teaching experience.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401v, 401vX. HISTORY OF INDUSTRIAL EDUCATION (2-3)
 402v, 402vX. SUPERVISION OF VOCATIONAL EDUCATION (2-3)
 403v, 403vX. SUPERVISED FIELD WORK (1-6)
 405v, 405vX. CONFERENCE LEADER TRAINING (2-3)
 408v, 408vX. OCCUPATIONS (2-3)
 409v, 409vX. TESTS AND MEASUREMENTS (2-3)
 412v, 412vX. SPECIAL PROBLEMS IN VOCATIONAL EDUCATION (2-4)
 414v, 414vX. VOCATIONAL EDUCATIONAL GUIDANCE (2-3)
 415vS, 415vX. PROBLEMS IN CO-ORDINATING VOCATIONAL EDUCATION (2-3)
 418v, 418vX. PROBLEMS IN AUDIO-VISUAL AIDS IN INDUSTRIAL EDUCATION (2-3)
 420v, 420vX. OCCUPATIONAL HYGIENE (2-3)
 425v, 425vX. WORKSHOP IN INDUSTRIAL EDUCATION (1-6)

INDUSTRIAL EDUCATION

- 427v, 427vX. ADVANCED COURSE OF STUDY BUILDING (2-3)
446vS, 446vX. IMPROVEMENT OF INSTRUCTION IN VOCATIONAL EDUCATION (2-4)
450v, 450vX. SHOP LAYOUT AND MANAGEMENT (2-3)
458v. EMERGING PROBLEMS IN VOCATIONAL EDUCATION (1-7)
 Unit A. *Federal and State Laws Relating to Vocational Education* (1)
 Unit B. *Framework of Federal, State, and Local Administrative Agencies* (1)
 Unit C. *Federal, State, and Local Policies and Plans for Vocational Education* (1)
 Unit D. *Local Administration of Vocational Education* (1)
 Unit E. *Labor Laws and Labor Relations Affecting Education* (1)
 Unit F. *Vocational Training for War and Postwar Eras* (1)
 Unit G. *Problems in Vocational Rehabilitation of the Physically Handicapped* (1)
460S. PROBLEMS IN VOCATIONAL REHABILITATION OF THE HANDICAPPED (1-6)
 Unit A. *The Counseling Interview in Vocational Rehabilitation* (1-3)
 Unit B. *Occupational Information and Placement Techniques in Vocational Rehabilitation* (1-3)

INDUSTRIAL ENGINEERING

PROFESSOR CLARENCE E. BULLINGER, I.E., M.S., P.E.

Head of the Department

501. MANUFACTURING METHODS (2-8) Special projects including investigation; experimentation, design, and research of some one or more special types of manufacture. *Professors Bullinger, Ekey, and Thuring*
502. MANAGEMENT METHODS (3-6) Intensive study of newer phases of scientific management, including production control and application of Gantt charts; research on special problems. *Professors Bullinger, Ekey, and Thuring*
503. PERSONNEL RELATIONS (2-8) Research on special topics. *Professor Bullinger*
505. GRAPHICAL COMPUTATION (2-10) Construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. *Professors Bullinger and Thuring*
506. TIME AND MOTION STUDY (3-9) Methods of research in motion and time study; critical analysis of current literature. *Professor Anderson*
507. BUDGETARY CONTROL AND STANDARD COSTS (3-6) Divisional budgets as control media; establishing standard cost data, standard cost accounting procedures, and use of cost variances in controlling manufacturing operations. Prerequisite: I.E. 335. *Professor Hussey*

INDUSTRIAL ENGINEERING

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 402, 402X. ENGINEERING ECONOMY (3) *Professors Bullinger and Roscoe*
404. SCIENTIFIC MANAGEMENT (2) *Professors Bullinger, Caldwell, and Roscoe*
406. FACTORY PLANNING (2) *Professor Thuering*
422a,b,c,d,e,f, 422a,b,c,d,e,fX. INDUSTRIAL ENGINEERING PROBLEMS (2-12) *Professors Bullinger, Anderson, Hussey, Thomas, Niebel, and Thuering*
423. QUALITY CONTROL (2) *Professors Bullinger and Ekey*
424. JOB EVALUATION (3) *Professor Thomas*
425, 425X. METHODS OF INDUSTRIAL OPERATIONS RESEARCH (3) *Professor Bullinger*
429. PLASTIC WORKING OF METALS (3) *Professor Roscoe*
430, 430X. INDUSTRIAL LEADERSHIP (3) *Professor Caldwell*

INSTITUTION ADMINISTRATION

PROFESSOR ESTHER A. ATKINSON, M.S.

Head of the Department of Hotel and Institution Administration

502. PROBLEMS IN INSTITUTIONAL ADMINISTRATION (3-6) Individual study of problems in institutional administration. Prerequisites: In.Adm. 326, 330. *Professor Atkinson*

In addition to this course, the following may be taken for graduate credit under the restrictions in force:

410. TEA ROOM MANAGEMENT (3)
437a,b,cS. SCHOOL CAFETERIA PROBLEMS (1-3)
 Unit A. Nutrition and Menu Planning (1)
 Unit B. Equipment (1)
 Unit C. Organization and Management (1)
438. SCHOOL LUNCH ADMINISTRATION (3)
461. INSTITUTION ADMINISTRATION (3)
462. INSTITUTION EXPERIENCE (3)

INTERNATIONAL UNDERSTANDING

Consult PROFESSOR WILLIAM H. GRAY, M.A., Ph.D.

The following course may be taken for graduate credit under the restrictions in force:

- 400S. WORLD AFFAIRS AND INTERNATIONAL UNDERSTANDING (3)

ITALIAN

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Head of the Department of Romance Languages

571. SEMINAR IN ITALIAN LITERATURE (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

JOURNALISM

PROFESSOR FRANKLIN C. BANNER, M.A.

Head of the Department

504. SEMINAR IN PENNSYLVANIA PRESS HISTORY (3)
505. INTERNATIONAL PRESS PROBLEMS (3-6) Legal and communications problems of the international flow of news and opinion; international press codes.
506. SEMINAR IN COMMUNICATIONS RESEARCH METHODS (3-6) Social science measuring techniques for readership and advertising studies, media effectiveness, and propaganda results.
513. NEWSROOM POLICIES (3) Case study of news desk ethics and news values; their impact on news story presentation.
568. SEMINAR IN LEGAL PROBLEMS IN FREEDOM OF THE PRESS (3-6)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. THE PRESS, ITS CRITICS AND ETHICS (3)
416. ADVANCED COPY READING (3)
424. ADVANCED REPORTING (3)
430. SUPERVISION AND MANAGEMENT OF SCHOOL PUBLICATIONS (3)
441. ADVANCED ADVERTISING COPYWRITING (3)
480. PROBLEMS OF PUBLISHING (3)

LATIN

PROFESSOR ROBERT E. DENGLER, A.M., Ph.D.

Head of the Department of Classical Languages

If the schedule of undergraduate work permits, the Department of Classical Languages will offer graduate work; but not more than one of the following courses will ordinarily be given in any one semester. Prospective students should confer with the department before registration.

500. LATIN LITERATURE (3) Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures. *Professor Dengler*
501. ROMAN RELIGION AND PHILOSOPHY (3) Development of religious concepts at Rome from primitive Italic origins to the advanced forms that culminated in Roman Stoicism. *Professor Krauss*
502. LATIN EPIGRAPHY (3) Lectures and readings on Roman inscriptions; illustrative exercises. *Professor Krauss*
503. LATIN PALEOGRAPHY (3) The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises. *Professor Dengler*
504. ROMAN TOPOGRAPHY (3) Physical development of the city of Rome, its walls, aqueducts, bridges, streets, fora, public buildings, temples, etc.; building materials and methods of construction. *Professor Krauss*
510. LATIN SEMINAR (3)
518. LATIN RESEARCH (1-3) Prosecution of an assigned problem under the guidance of a member of the department. *Professor Dengler*
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
428. LUCRETIVS (3) *Professor Krauss*
429. QUINTILIAN (3) *Professor Krauss*
431. JUVENAL (3) *Professor Krauss*
- 436S. FUNCTIONAL PROBLEMS IN LATIN (3)
- 440a,b,c,dS. COLLEGE LATIN (3-12) *Professor Dengler*

LIBRARY SCIENCE

Consult LIBRARIAN RALPH W. McCOMB, M.A.

The following courses may be taken for graduate credit under the restrictions in force:

- 403S. INTERMEDIATE DICTIONARY CATALOGING AND SUBJECT HEADINGS (2-3)
- 405S. INTERMEDIATE REFERENCE WORK AND BIBLIOGRAPHY (2-3)
- 407S. SPECIAL PROBLEMS IN SCHOOL LIBRARY SERVICE (6)

MATHEMATICS

PROFESSOR ORRIN FRINK, JR., M.A., Ph.D.

Head of the Department

500. ANALYTICAL MECHANICS (3) An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math. 419 or Phys. 461.

MATHEMATICS

- 501-502. **THEORY OF FUNCTIONS OF A REAL VARIABLE** (3 each) Theory of real functions, sets, measure, derivatives, and integrals. Prerequisite: Math. 420.
503. **FOURIER SERIES AND HARMONIC FUNCTIONS** (3) Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisites: Math. 90, 420.
505. **INTEGRAL EQUATIONS** (3) Fredholm and Volterra equations, and applications. Prerequisite: Math. 421.
507. **CALCULUS OF VARIATIONS** (3) Prerequisites: Math. 90, 421.
- 508-509. **THEORY OF FUNCTIONS OF A COMPLEX VARIABLE** (3 each) Development of the complex number system; theory of analytic functions. Prerequisite: Math. 421.
510. **THEORY OF GROUPS** (3) General properties of groups with applications. Prerequisite: Math. 471 or 535.
511. **LINEAR ALGEBRA AND MATRIX THEORY** (3) Vector spaces and linear transformations, canonical representations, elementary divisors and invariant factors. Prerequisite: Math. 481.
- 513-514. **ADVANCED ANALYTIC GEOMETRY** (3 each) Introduction of homogeneous co-ordinates and their use in the study of projective properties. Prerequisite: Math. 30.
- 520-521. **PROJECTIVE GEOMETRY** (3 each) General study of the subject from the postulational standpoint. Prerequisite: Math. 30. Alternate years or as required.
- 522-523. **METRIC DIFFERENTIAL GEOMETRY** (3 each) The usual classical treatment of the subject. Prerequisite: Math. 11 or 30.
- 530-531. **TOPOLOGY** (3 each) Topological spaces, combinatorial topology, applications to algebra and analysis.
534. **THEORY OF ALGEBRAIC NUMBERS** (3) Introduction to the number theory of quadratic fields, with study of the theory of ideals in quadratic and higher fields, with application. Prerequisites: Math. 404, 471.
- 535-536. **MODERN ALGEBRAIC THEORIES** (3 each) Groups, rings, ideals, algebraic number fields, Galois theory. Prerequisite: Math. 471.
- 542-543. **THEORY OF STATISTICS** (3 each) Univariate and multivariate distributions, sampling distributions, theory of estimation, statistical hypotheses. Prerequisites: Math. 409, 421.
- 550-551. **MATHEMATICAL LOGIC** (3 each) The logical basis of mathematics and its ultimate nature. Prerequisite: Math. 471 or Phil. 428.
- 552-553. **NUMERICAL METHODS** (3 each) Procedures for practical calculation, including interpolation, solution of equations, iterative methods, harmonic analysis and use of modern calculating equipment. Prerequisite: Math. 420.

- 560-561. THEORY OF DIFFERENTIAL EQUATIONS (3 each) Prerequisites: Math. 90, 421.
570. SPECIAL TOPICS IN GEOMETRY (3-6)
571. SPECIAL TOPICS IN ANALYSIS (3-6)
572. SPECIAL TOPICS IN ALGEBRA (3-6)
573. SPECIAL TOPICS IN APPLIED MATHEMATICS (3-6)
574. SPECIAL TOPICS IN FOUNDATIONS OF MATHEMATICS (3-6)
- 575-576. MATHEMATICS SEMINAR (1-6 each) Selected topics from recent mathematical developments.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

403. MODERN METHODS IN GEOMETRY (3)
404. THEORY OF NUMBERS (3)
405. PARTIAL DIFFERENTIAL EQUATIONS (3)
407. FOUNDATIONS OF ALGEBRA AND GEOMETRY (3)
408. APPLICATIONS OF MATHEMATICS (3)
- 409, 409X. THEORY OF PROBABILITY (3)
410. STATISTICAL METHODS (3)
411. FINITE DIFFERENCES (3)
- 412S. ALGEBRAIC EQUATIONS (3)
417. VECTOR ANALYSIS (3)
419. ANALYTICAL MECHANICS (3)
- 420-421. ADVANCED CALCULUS (3 each)
424. LEAST SQUARES (2)
425. CURVE FITTING (1)
431. DIFFERENTIAL EQUATIONS (3)
441. THEORY OF EQUATIONS (3)
- 451-452. INTRODUCTION TO APPLIED MATHEMATICS (3-6 each)
471. FOUNDATIONS OF ALGEBRA (3)
472. FOUNDATIONS OF GEOMETRY (3)
481. VECTORS AND MATRICES (3)

MECHANICAL ENGINEERING

PROFESSOR NORMAN R. SPARKS, M.E.

Head of the Department

502. ADVANCED GAS TURBINES (3-6) Thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.
504. ADVANCED ENGINEERING THERMODYNAMICS (3-6) Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisites: M.E. 31, 32.

MECHANICAL ENGINEERING

505. HEAT TRANSMISSION (3-6) Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412.
506. MECHANICAL ENGINEERING SEMINAR (1-4) Advanced courses adapted to the individual requirements of graduates in mechanical engineering.
507. ADVANCED INTERNAL COMBUSTION ENGINES (3) Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504.
510. FUEL INJECTION AND COMBUSTION IN DIESEL ENGINES (3-6) Characteristics and efficiency of various injection systems.
511. FUEL SPRAY LABORATORY (3) Laboratory study of fuel injection for the Diesel engine.
512. SCAVENGING OF TWO-STROKE CYCLE ENGINES (3) Design of ports, valves, blowers, intake and exhaust manifolds for proper scavenging and charging of engines, particularly two-stroke cycle Diesel engines; experimental technique in evaluating scavenging. Prerequisite: M.E. 413.
513. FUEL FEEDING DEVICES FOR INTERNAL COMBUSTION ENGINES (3) Carburetors and injection equipment for Otto and Diesel engines and for liquid-fuel turbines, including the required control devices.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401a,b,c,d. MECHANICAL ENGINEERING (3-12)
402. AIR CONDITIONING (3)
408. STEAM TURBINES (3)
409. GAS TURBINES (3)
410. STEAM POWER PLANTS (3)
- 411, 411X. REFRIGERATION (3)
- 412, 412X. FUNDAMENTALS OF HEAT TRANSFER (3)
413. INTERNAL COMBUSTION ENGINES (3)
416. RESISTANCE AND POWERING OF SHIPS (3)
417. THEORY OF ENGINEERING INSTRUMENTS (3)

MECHANICAL ENGINEERING DESIGN

Consult PROFESSOR MAURICE S. GJESDAHL, M.S.

502. FRICTION AND LUBRICATION (3) The hydrodynamic theory of lubrication and methods of applying it to bearing design, together with a survey of methods of testing lubricants.
505. ADVANCED DYNAMICS OF MACHINES (3-6) Linear and torsional vibrations in and balancing of rotating and reciprocating machinery; exact analysis of stresses produced by these and other dynamic forces in machine parts. Prerequisites: Mchs. 12, M.E.Des. 8.

MECHANICAL ENGINEERING DESIGN

506. MECHANISM SYNTHESIS (3) Design and analysis of mechanisms for specific motion and energy requirements; intermittent mechanisms. Prerequisite: M.E.Des. 406.

507. AUTOMATIC CONTROL SYSTEMS (3) Advanced problems and techniques in the design of automatic control systems with emphasis on stability, controller design, and optimum performance. Prerequisite: M.E.Des. 407.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

402. DESIGN OF MACHINE TOOLS (3)

403. ADVANCED MACHINE DESIGN PROBLEMS (3)

404. MACHINE DESIGN ANALYSIS (3)

405. BEARING DESIGN AND LUBRICATION (3)

406. ADVANCED MECHANISMS (3)

407. AUTOMATIC CONTROL SYSTEMS (3)

MECHANICAL ENGINEERING LABORATORY

Consult PROFESSOR EDGAR E. AMBROSIUS, M.S., P.E.

501. INVESTIGATION PROJECTS (2-6) Special experimental studies or investigations in mechanical engineering, adapted to individual requirements.

METALLURGY

PROFESSOR AMOS J. SHALER, Sc.D.

Head of the Department

501. METALLURGICAL PROBLEMS (1-6 per semester) Independent study of special problems in metallurgy. Prerequisites: Met. 411, 413.

502. METALLURGICAL SEMINAR (1 per semester) Conferences, reading, and reports. Required of all graduate students in metallurgy.

Professor Shaler

515. CORROSION OF METALS (3) Phenomena and theories of metallic corrosion; principles of alloy selection for engineering and structural uses in corrosive environments. Prerequisites: Met. 411, 413.

Professor Read

516. MECHANICAL METALLURGY (3) Theories of plastic flow in polycrystalline metals; calculations of simple and combined stresses and application to metal forming and mechanical tests. Prerequisites: Met. 411, 413.

Professor Shaler

518. CONSTITUTION OF METALLURGICAL SYSTEMS (3) Application of thermodynamic principles to study of heterogeneous equilibrium in alloy, slag, and slag-metal systems. Prerequisites: Met. 411, 413.

Professor Davis

METALLURGY

519. ADVANCED FERROUS METALLURGY (3) Physicochemical principles in the smelting and refining of iron and steel; slag control; solidification and primary forging of steel. Prerequisites: Met. 411, 413. *Professor Davis*
520. FOUNDRY METALLURGY (3) Principles of foundry metallurgy; application to foundry operations for various ferrous and nonferrous casting alloys. Prerequisites: Met. 411, 413. *Professor Lindsay*
521. ENGINEERING ALLOYS (3) Requirements and applications of industrial alloys: mechanical, thermal, electrical, and magnetic properties. Prerequisites: Met. 411, 413. *Professor Lindsay*
522. SOLID PHASE REACTIONS IN METALS (3) Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitations from solid solution, eutectoid decomposition and order-disorder phenomena. Prerequisites: Met. 411, 413. *Professor Lindsay*
523. BEHAVIOR OF METAL CRYSTALS (3) Plastic action in single crystals of metals and in polycrystalline metals, theoretical crystal plasticity, recovery, and recrystallization, deformation and recrystallization textures, anisotropy in general. Prerequisites: Met. 411, 413.
525. METAL FINISHING (3) Metallic coatings and their metallurgical properties; theories and problems of application, utilization, and evaluation. Prerequisites: Met. 411, 413. *Professor Read*

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in metallurgical studies are listed under Mineral Sciences.*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

405. FERROUS METALLOGRAPHY (3)
406. NONFERROUS METALLOGRAPHY (3)
407. METALLURGICAL ENGINEERING I (3)
408. METALLURGICAL ENGINEERING II (3)
409. METALLURGICAL INVESTIGATIONS I (3)
410. METALLURGICAL INVESTIGATIONS II (3)
411. ADVANCED PHYSICAL METALLURGY (3)
412. EXPERIMENTAL METALLURGY (3)
413. ADVANCED CHEMICAL METALLURGY (3)

METEOROLOGY

PROFESSOR HANS NEUBERGER, D.Sc.

Head of the Department

500. METEOROLOGICAL SEMINAR (1-3) Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteo. 412, 451.

502. SELECTED TOPICS OF ADVANCED METEOROLOGY (2) Current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology.
503. ATMOSPHERIC TURBULENCE (3) Atmospheric diffusion, heat conduction, friction, and evaporation; statistical properties of turbulence.
504. ADVANCED DYNAMIC METEOROLOGY (3) Introduction to perturbation theory with application to gravitational and long waves; principles of dynamic-numerical forecast methods. Prerequisite: Meteo. 452.
505. BIOCLIMATOLOGY (2) Climatic phenomena in their relation to life. Prerequisite: Meteo. 472.
506. ADVANCED METEOROLOGICAL ANALYSIS (2-6) Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteo. 412.
507. DYNAMIC OCEANOGRAPHY (2) Physical properties of sea water; heat balance of the oceans; theory and observations of ocean currents, waves, and tides.
508. PHYSICS OF THE UPPER ATMOSPHERE (2) Temperature distribution, composition, and electrical characteristics of the upper atmosphere; theories of aurora and light of the night sky.
509. THEORETICAL CLIMATOLOGY (2) Theory of latitudinal, annual, and diurnal temperature changes; theories of climatic changes; microclimate.
510. CLOUD PHYSICS (2) Current theories on phase changes in clouds and mechanisms responsible for precipitation; techniques of cloud modification and control.

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in meteorological studies are listed under Mineral Sciences.*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

411. SYNOPTIC METEOROLOGY I (3)
412. SYNOPTIC METEOROLOGY II (3)
431. SYNOPTIC METEOROLOGY LABORATORY I (3)
432. SYNOPTIC METEOROLOGY LABORATORY II (2-10)
433. ADVANCED SYNOPTIC ANALYTICAL TECHNIQUES (3)
443. PHYSICAL METEOROLOGY (3)
445. HYDROMETEOROLOGY (3)
450. APPLICATIONS OF STATISTICS TO METEOROLOGY (3)
451. DYNAMIC METEOROLOGY I (3)
452. DYNAMIC METEOROLOGY II (3)
461. THEORY OF METEOROLOGICAL INSTRUMENTS (3)
472. PHYSICAL AND DYNAMIC CLIMATOLOGY (3)
492. METEOROLOGICAL SEMINAR (2)

MINERAL ECONOMICS

MINERAL ECONOMICS

PROFESSOR JOHN D. RIDGE, S.M., Ph.D.

Head of the Department

500. MARKETING OF MINERALS AND MINERAL PRODUCTS (3-6) Research in mineral marketing problems.
501. RESEARCH IN MINERAL ECONOMICS (3-6) Investigation in specialized fields of research in mineral economics.
502. TECHNOLOGIC INFLUENCES (3-9) Relationship of technologic advancements to financial development of the mineral industries.
505. PROBLEMS OF MINERAL ECONOMICS (3-12) Determination of basic technologic-economic patterns of selected mineral industries. Prerequisite: Min.Ec. 87.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. SEMINAR (1)
453. NONMETALLIC MINERALS (3)
463. MINERAL ECONOMY OF THE U.S.S.R. (3)
483. THE METALS AND THEIR ORES (3)
484. THE SOLID FUELS (3)
486. PETROLEUM AND NATURAL GAS ECONOMICS (3)
490. MINERAL VALUATION (3)
491. ANALYSIS OF MINERAL DATA (2)

MINERAL INDUSTRIES

Consult PROFESSOR BENJAMIN F. HOWELL, JR., M.S., Ph.D., P.E.

The following course may be taken for graduate credit under the restrictions in force:

400. MINERAL INDUSTRIES IN MODERN CIVILIZATION (3)

MINERAL PREPARATION

PROFESSOR H. BEECHER CHARMBURY, M.S., Ph.D.

Head of the Department

502. FROTH FLOTATION AND AGGLOMERATION (3) Intensive study of theory and applications of froth flotation and agglomeration. Prerequisite: Min.Pr. 405. *Professor Sun*
504. MINERAL PREPARATION RESEARCH (3-10) Research work on specific problems in mineral preparation. Prerequisite: Min.Pr. 405 or 410. *Professor Charmbury and Staff*

MINERAL PREPARATION

505. GRAVITY PROCESSES AND MISCELLANEOUS METHODS OF MINERAL PREPARATION (3) Intensive study of theory and applications of gravity, magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Min.Pr. 405. *Professor Mitchell*

506. MINERAL PREPARATION PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Min.Pr. 405. *Professor Mitchell*

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in mineral preparation studies are listed under Mineral Sciences.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 400. MINERAL PREPARATION SEMINAR (1)
- 403. FLOWSHEETS OF MINERAL PREPARATION PLANTS (2)
- 404. PLANT LAYOUT AND DESIGN (3)
- 405. UNIT OPERATIONS (3)
- 406. MINERAL PREPARATION TESTING (2)
- 410. COAL PREPARATION (3)

MINERAL SCIENCES

Consult PROFESSOR THOMAS F. BATES, M.A., Ph.D.

510. X-RAY AND ELECTRON DIFFRACTION ANALYSIS AS APPLIED TO MINERALS AND METALS (2) Prerequisite: Phys. 285. *Professor Brindley*

520. ELECTRON MICROSCOPY IN MINERAL SCIENCE RESEARCH (1-4) Prerequisite: Min.Sc. 411, Unit B. *Professor Bates, Mr. Comer*

530. SPECTROSCOPY IN MINERAL SCIENCE RESEARCH (1-4) Prerequisite: Min.Sc. 411, Unit C. *Professor Lovell*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

411. INSTRUMENT TECHNIQUES APPLIED TO MINERAL SCIENCE PROBLEMS (1-3)

- Unit A. X-Ray Diffraction*
- Unit B. Electron Microscopy*
- Unit C. Spectroscopy*

MINERALOGY

PROFESSOR PAUL D. KRYNINE, Ph.D.

Head of the Department

500. PHYSICAL MINERALOGY (3) Optical methods and measurement of optical constants of minerals. *Professors Krynine and Bates*

MINERALOGY

- 501a. PETROLOGY (3-6) Microscopic study of rocks, emphasizing classification and genetic relationships. *Professors Krynine, Tuttle, and Griffiths*
- *502. MINERALOGICAL PROBLEMS (3-18) Original study of some mineralogical problem, results of which may be applied on the thesis requirements.
504. THEORETICAL MINERALOGY (2) Crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena. Prerequisite: Min. 461. *Professor Bates*
505. MINERALOGY SEMINAR (1-2) Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students. *Professors Krynine, Tuttle, Bates, Griffiths, and Brindley*
- †510. METAMORPHIC PETROLOGY (2-6) Detailed review of chemical, mineralogical, and structural changes that take place during metamorphism. Prerequisite: Min. 483. *Professors Krynine, Tuttle, Bates, and Griffiths*
511. SEDIMENTARY PETROLOGY (3-4) Composition, texture, structure, mass properties of sediments; dynamic processes in complex natural systems; sedimentary stages: weathering, erosion, transport, deposition, and lithification. Prerequisite: Min. 483. Concurrent: Min. 513. *Professor Krynine*
512. SEDIMENTARY PETROLOGY, CONTINUED (2-4) Diastrophism and tectonic background of sedimentation; depositional loci; classification of sediments: quartzites, graywackes, arkoses; chemical sediments; paleogeography, paleoclimatology, oil finding. Prerequisite: Min. 511. Concurrent: Min. 514. *Professor Krynine*
513. METHODS OF ANALYSIS OF SEDIMENTS (2) Principles and practices used in analyzing sedimentary rocks for size, shape, and accessory (heavy) minerals. Concurrent: Min. 511. *Professor Griffiths*
514. APPLIED SEDIMENTOLOGY (3) Design and control in analysis of sedimentary rocks; application of these techniques to industrial problems. Concurrent: Min. 512. *Professor Griffiths*
515. MINERALOGY OF CLAYS AND OTHER FINE-GRAINED MATERIALS (2-3) Physical and chemical properties of clay minerals; importance and application of X-ray diffraction, differential thermal analysis, light and electron microscopy. Prerequisite: Min. 460. *Professor Bates*
516. PETROLOGY OF FINE-GRAINED SEDIMENTS (2-3) Fine-grained sedimentary rocks and their industrial applications. Prerequisite: Min. 515. *Professor Griffiths*
- ‡517. EUROPEAN SEDIMENTS (1-6) Interpretative microscopic and hand specimen study of selected rock suites from Europe and Asia; correlation with paleogeographic and tectonic data. Prerequisites: Min. 512, 514. *Professor Krynine*

*Credits to be arranged, 3-9 per semester.

†Credits to be arranged, 2-4 per semester.

‡Credits to be arranged, 1-3 per semester.

- †518. AMERICAN SEDIMENTS (2-8) Thin section, heavy residue, textural and field data of arkoses, graywackes, quartzites, and carbonates from representative North American sedimentary provinces. Prerequisites: Min. 512, 514, 516. *Professor Krynine*
- §519. OIL RESERVOIR PETROLOGY (2-6) Petrographic fundamentals controlling porosity, storage capacity, oil accumulation, effective permeability, fluid yield and retention, exploration and production methods. Prerequisites: Min. 512, 514, 516. *Professors Krynine and Griffiths*
520. STUDY OF ACCESSORY MINERALS (2-4) Detailed study of accessory (heavy) minerals; their significance in problems of provenance, petrogenesis, mineral stratigraphy, and paleogeography. Prerequisites: Min. 511, 512, 513, 514. *Professor Griffiths*
521. COLOR IN MINERALS (1-2) Nature of light absorption as a function of chemical composition for solutions, glasses, and minerals. *Professor Weyl*
- §523. X-RAY DIFFRACTION STUDIES OF MINERALS (2-6) Investigation of mineralogical problems with X-rays. Practicum includes preparation of samples, use of X-ray apparatus, and interpretation of patterns. Prerequisite: Min. 461. *Professor Brindley*
524. INTRODUCTION TO SEDIMENTATION (3) Concurrent: Min. 483. *Professor Krynine*
525. IGNEOUS PETROLOGY (2-6) Origin, distribution, and composition of igneous rocks. Prerequisite: Min. 483. *Professor Tuttle*
- NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in mineralogical studies are listed under mineral sciences.
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
460. PHYSICAL MINERALOGY (3) *Professor Wright*
 461. DESCRIPTIVE MINERALOGY (4) *Professor Bates*
 483. PETROGRAPHY (4) *Professors Griffiths and Thornton*

MINING

PROFESSOR ARNOLD W. ASMAN, B.Sc., P.E.

Head of the Department

500. MINING SEMINAR (2) Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering.
501. MINE ENGINEERING (3) Mine mechanization problems. Selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488.

†Credits to be arranged, 2-4 per semester.

§Credits to be arranged, 2-3 per semester.

MINING

504. MINING RESEARCH (3-10 per semester) Research work on specific problems in physics of mining and mine mechanization. Prerequisite: Mng. 481.
506. MINE AND MINE PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499.
520. MINE PLANNING USING CYCLE STUDIES (3-6) Highly productive cycles of mine section operation are developed by use of time and method studies of the various sub-cycles involved. Prerequisite: Mng. 472.
521. MATHEMATICAL ANALYSIS OF MINE LAYOUTS (3) Proportioning layouts in regard to mineral available, distances, and centroids of mining areas; incremental and sub-cycle costs. Prerequisite: Mng. 488.
522. ROCK MECHANICS (3-6) Detailed study of the physical properties of rocks as affecting the design of underground openings; testing procedures, calculations, and design. Prerequisite: Mng. 499.
523. MINE DUSTS (3) Detailed studies of methods of collecting, sampling, and determining amount, size, and mineral content of dust in mine atmospheres; methods of dust control. Prerequisite: Mng. 481.
524. UNDERGROUND MINING POWER DISTRIBUTION SYSTEMS (3-6) Calculations involved in the design of power applications and systems for mines; electrical, compressed air; Diesels; package power for extremely gassy conditions; sectionalizing; loads and load centers. Prerequisite: Mng. 488.

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in mining studies are listed under Mineral Sciences.*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. MINE SAFETY ENGINEERING (2)
471. MINE MECHANIZATION (3)
472. MINING DESIGN (3)
481. MINE VENTILATION (4)
484. MINE COST CONTROL (2)
488. ADVANCED MINE MECHANIZATION (3)
494. MINE MANAGEMENT ENGINEERING (3)
499. MINE PRODUCTION CONTROL (2)

MUSIC

PROFESSOR HUMMEL FISHBURN, M.A., Mus.D.

Head of the Department

- 503-506. ADVANCED STRINGED INSTRUMENTS (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 103-106.
Fee \$25 per course.

Professor Karhan

511-514. ADVANCED PIANO (3 per course) Piano literature of all periods; stress laid on developing technique and preparing for public performance. Fee \$25 per course. *Professor Brinsmaid*

531-534. ADVANCED ORGAN (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 31-34. Fee \$30 per course. *Professor Ceiga*

543. MODERN HARMONY (3) Harmonic writing based on 20th century practices with attention to traditional idioms that serve as foundation. *Professor Henninger*

558-561. FREE COMPOSITION (3 per course) Composition: vocal and instrumental, standard or modern idioms. Prerequisite: 18 credits in harmony, counterpoint, and piano. *Professor Henninger*

563. FREE ARRANGING (3) Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisite: 18 credits in harmony, including 3 of orchestration. *Professor Fishburn*

567. THE LITERATURE OF THE ORCHESTRA (3) The suite, symphony, tone poem, and overture from the point of view of appreciation, form, and orchestration. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra. *Professor Fishburn*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

407. PIANO REPERTOIRE (3) *Professor Brinsmaid*

408. VOCAL LITERATURE (3)

410. MUSIC OF THE 20TH CENTURY (3)

411. LITERATURE OF THE VIOLIN (3)

429-432. SINGER'S STYLE AND INTERPRETATION (3 per course) Fee \$25 per course. *Professor Taylor*

456. ELEMENTARY COUNTERPOINT (3) *Professor Henninger*

466. ADVANCED CONDUCTING (3) *Professor Gullo*

MUSIC EDUCATION

PROFESSOR HUMMEL FISHBURN, M.A., Mus.D.

Head of the Department

500. MUSIC EDUCATION SEMINAR (3-6) Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems.

569. PRESENT-DAY TRENDS IN INSTRUMENTAL MUSIC (3) New methods and materials for band, orchestra, and ensembles.

571. VOCAL PEDAGOGY (3) Detailed study of vocal problems met in public schools, elementary through high school; vocal class pedagogy and literature; daily voice training. Prerequisites: Mus.Ed. 48, teaching experience.

MUSIC EDUCATION

572. INSTRUMENTAL PEDAGOGY (3-6) Research problems in band and orchestra. Prerequisite: Mus.Ed. 54 or practical experience.
573. THE MATERIALS OF APPRECIATION (3) Methods and materials for development of music appreciation in elementary and secondary schools. Prerequisites: Music 5, teaching experience.
- 574a,b. PRESENT-DAY TRENDS IN MUSIC EDUCATION (3-6) Present-day music education materials and methods (elementary and secondary levels) in relation to modern educational philosophy; emphasis upon practical problems presented by members of the class. Prerequisites: Mus.Ed. 48, teaching experience.
575. THE JUNIOR HIGH SCHOOL MUSIC CURRICULUM (3) Instructional materials, procedures, curricular and extracurricular activities, integration with other subjects.
576. MUSIC SUPERVISION (3) Current educational procedures in training music supervisors.
580. FIELD PROJECTS IN JUNIOR AND SENIOR HIGH SCHOOL MUSIC (3) Curricular problems to be carried on under actual school conditions; individual work under supervision. Prerequisites: teaching experience, 30 credits of graduate study.
594. PEDAGOGY OF EAR TRAINING (3) Materials and methods for training the listener to grasp, understand, and write what is heard from melody to four-part harmony. Prerequisite: 12 credits in ear training and/or harmony.
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
401. MUSIC IN THE RURAL AREA (3)
462. PEDAGOGY OF THEORY (3)
468. THE TEACHING OF PIANO (3)
469. BAND AND ORCHESTRA TECHNIQUE (3)
470. CHORAL TECHNIQUE (3)
- 475, 475X. OBJECTIVES AND PROBLEMS IN ELEMENTARY MUSIC EDUCATION (3)

PETROLEUM AND NATURAL GAS

PROFESSOR JOHN C. CALHOUN, M.S., Ph.D., P.E.

Head of the Department

500. PETROLEUM AND NATURAL GAS ENGINEERING PROBLEMS (3-9 per semester)
501. ENERGETICS OF PETROLEUM ENGINEERING (3) Applications of thermodynamics to special problems in production of petroleum and natural gas.
502. PETROLEUM AND NATURAL GAS ENGINEERING SEMINAR (3-9) Intensive study of one or several phases of petroleum engineering.

PETROLEUM AND NATURAL GAS

503. THE FLOW OF HOMOGENEOUS FLUIDS THROUGH POROUS MEDIA (3) Flow and pressure distributions for various geometric patterns for steady and unsteady states. Prerequisite: Math. 431.
504. WATER FLOODING (3-6) Continuation of Pet.E. 485 with emphasis on special problems. Prerequisite: Chem. 460.
506. ADVANCED PETROLEUM ENGINEERING (5) Advanced problems in petroleum and natural gas production. Prerequisites: Chem. 461, Pet.E. 310.
507. CONDENSATE FIELDS (2) Retrograde condensation phenomenon of hydrocarbon mixtures at high pressures; literature on condensate fields; production methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: Pet.E. 501.
508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Principles of colloidal activity applied to control of properties of clay slips, drilling fluids, and similar suspensions. (In co-operation with the Ceramics staff.) Prerequisite: Chem. 461. *Professor Henry*
509. ADVANCED PETROLEUM ENGINEERING DESIGN (2) Continuation of Pet.E. 320. Projects in selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: Pet.E. 320.

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in petroleum and natural gas studies are listed under Mineral Sciences.*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

420. EXPLOITATION AND DEVELOPMENT ENGINEERING (3)
481. NATURAL GAS AND GASOLINE PLANTS (3)
483. NATURAL GAS LABORATORY (1)
485. SECONDARY RECOVERY (3)
490. ADVANCED CORE TESTING (3)

PHILOSOPHY

PROFESSOR ERNEST H. FREUND, Ph.D.

Acting Head of the Department

- 500a,b. ETHICAL SEMINAR (2-6) Critical study of some phase of ethical fact and theory.
- 501a,b,c,d. PHILOSOPHY SEMINAR (2-12) Meets the demand for advanced study in special fields of philosophical thought.
503. LOGIC (3) The logical basis of mathematics and its ultimate nature.
504. SOCIAL AND POLITICAL PHILOSOPHY (3) Critical study of basic problems in their historical and functional setting.

PHILOSOPHY

505. IDEALS OF WESTERN CIVILIZATION (3) Analysis of contemporary ideals in terms of their Graeco-Judean bases.
507. SEMINAR IN HISTORY OF WESTERN PHILOSOPHY (3-12)
510. CLASSICS OF SCIENTIFIC METHOD (3) Actual reasoning and procedures of historical masters of scientific methods.
511. PRINCIPLES OF EXPERIMENTAL INFERENCE (3) Science as controlled inquiry; types of scientific procedures in formal, physical, and sociocultural science.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. RELIGIOUS PHILOSOPHY OF THE GREAT REFORMERS (3)
- 404X. ADVANCED HISTORY OF PHILOSOPHY (3)
405. PHILOSOPHY OF ST. AUGUSTINE (3)
409. PHILOSOPHY OF ST. THOMAS AQUINAS (3)
414. AESTHETIC THEORY (3)
415. THE PHILOSOPHY OF KANT (3)
418. RECENT AND CONTEMPORARY PHILOSOPHY (3)
419. PHILOSOPHICAL BACKGROUNDS OF AMERICAN THOUGHT (3)
425. PHILOSOPHY OF LAW (3)
426. METAPHYSICS (3)
427. ADVANCED ETHICS (3)
428. ADVANCED LOGIC (3)
429. SEMANTICS: PHILOSOPHY OF LANGUAGE AND SYMBOLISM (3)
430. PHILOSOPHICAL PROBLEMS (3-6)
450. TYPES OF PHILOSOPHY (3)

PHYSICAL EDUCATION

PROFESSOR JOHN D. LAWThER, M.A., D.Pd.

Assistant Dean of the College of Physical Education and Athletics

500. PROBLEM IN PHYSICAL EDUCATION (3) Prerequisite: Ph.Ed. 455.
522. ORGANIZATION AND ADMINISTRATION OF PHYSICAL EDUCATION IN COLLEGES AND UNIVERSITIES (3) Administration of physical education in college; credits, schedules, excuses, records, reports, budgets, classification, tests, staff, and facilities. Prerequisite: Ph.Ed. 491. *Professor Bedenk*
523. ADMINISTRATION OF COLLEGE ATHLETICS (3) Eligibility, schedules, managerial systems, relationships of athletics to the physical education program and to education in general. Prerequisite: Ph.Ed. 491. *Professor Bedenk*
526. ATHLETIC PROBLEMS IN SCHOOLS (3) Practical problems which result from administration of athletics in schools. Reports on some aspects of athletics required. Prerequisite: Ph.Ed. 460. *Professor Bedenk*

PHYSICAL EDUCATION

528. PROFESSIONAL EDUCATION OF TEACHERS OF HEALTH AND PHYSICAL EDUCATION (3) Health and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems. Prerequisite: Ph.Ed. 491. *Professor Jones*
529. SUPERVISION OF PHYSICAL EDUCATION IN SCHOOLS (3) Methods and policies of the school supervisor of physical education; conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher. Prerequisite: Ph.Ed. 491. *Professors Thiel and Lucey*
530. RESEARCH TECHNIQUES IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Ph.Ed. 490. *Professor Lawther*
531. RESEARCH IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Ph.Ed. 530. *Professor Gross*
532. TESTS AND MEASUREMENTS IN PHYSICAL EDUCATION (3) Critical study of tests and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Ph.Ed. 490. *Professor Gross*
534. STUDIES IN CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION (3) Principles and methods of curriculum building in physical education; different psychological and educational points of view, organizing a course of study committee, making units of instruction. Prerequisite: Ph.Ed. 454. *Professor Lawther*
535. MODERN FOREIGN SYSTEMS OF PHYSICAL EDUCATION (3) Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Ph.Ed. 534, 595. *Professor Speidel*
536. SCIENTIFIC METHODS IN ATHLETIC COACHING (3) Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Ph.Ed. 460. *Professor Lawther*
550. SEMINAR IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (1-6) Open only to students preparing approved theses and dissertations. *Professor Lawther and Staff*
555. RELATIONSHIPS OF PHYSICAL EDUCATION TO THE EXACT SCIENCES (3) *Professor Lucey*
560. ADMINISTRATIVE PROBLEMS OF PHYSICAL EDUCATION IN SCHOOLS (3) Solutions to problems emerging from the administration of physical education in schools, fitting physical education into the school's schedule, awards and budgets. Prerequisite: Ph.Ed. 491. *Professor Thiel*
581. PROBLEMS IN BODY MECHANICS (3) Certain aspects of human motion and body segmental alignment; analysis of human gait, and the dynamic adaptation of the spine, thorax, and pelvis to external physical forces. Prerequisite: Hl.Ed. 244, Ph.Ed. 399. *Professor Lucey*

PHYSICAL EDUCATION

595. PHILOSOPHY OF HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION (3) Prerequisite: Hl.Ed. 453 or Ph.Ed. 491 or Recr. 465.

Professor Lawther

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

424. MODERN TRENDS IN HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS (3) *Professor Thiel*
- 429S. THE MODERN DANCE IN EDUCATION (3) *Professor Briant*
- 431S. COACHING OF ADVANCED BASEBALL (3) *Professor Bedenk*
- 436S. COACHING OF ADVANCED FOOTBALL (3) *Professor Engle*
- 437S. COACHING OF ADVANCED BASKETBALL (3) *Professor Gross*
- 438S. COACHING OF ADVANCED TRACK (3) *Professor Werner*
- 439S. COACHING OF ADVANCED SOCCER (3)
- 440S. COACHING OF ADVANCED GYMNASTICS (3) *Professor Wettstone*
- 441S. ADVANCED COACHING OF ATHLETICS FOR MEN (1-11)
- Unit A. Basketball (1) *Professor Gross*
- Unit B. Football (1) *Professor Engle*
- Unit C. Track and Field (1) *Professor Werner*
- Unit D. Baseball (1) *Professor Bedenk*
- Unit E. Wrestling (1) *Professor Speidel*
- Unit F. Soccer (1)
- Unit G. Swimming (1) *Professor Gutteron*
- Unit H. Gymnastics (1) *Professor Wettstone*
- Unit I. Boxing (1) *Mr. Sulkowski*
- Unit J. Lacrosse (1) *Professor Thiel*
- Unit K. Fencing (1) *Professor Meyer*
- 449S. ADVANCED TEACHING OF SPORTS AND RHYTHMICS (1-11)
- Unit A. Soccer and Speedball (1) *Professor Lucey*
- Unit B. Basketball (1) *Professor Lucey*
- Unit C. Field Hockey (1) *Professor Lucey*
- Unit D. Archery (1) *Professor Haidt*
- Unit E. Swimming (1) *Professor Bleick*
- Unit F. Rhythmics for Children (1) *Professor Briant*
- Unit G. Modern Dance and Accompaniment (1) *Professor Briant*
- Unit H. Early American Country Dancing and Social Dancing (1) *Professor Briant*
- Unit I. Tennis (1) *Professor Lucey*
- Unit J. Badminton (1) *Professor Lucey*
- Unit K. Golf (1) *Mr. Rutherford*
- 452S, 452X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE ELEMENTARY SCHOOL (3) *Professor Speidel*
- 453S, 453X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE HIGH SCHOOL (3) *Professor Bischoff*
454. THE NATURAL PROGRAM OF PHYSICAL EDUCATION ACTIVITIES, APPLIED (3) *Professor Bischoff*
455. SCIENTIFIC METHOD IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Gross*
460. METHODS AND PRINCIPLES OF ATHLETIC COACHING (3) *Professor Lawther*

PHYSICAL EDUCATION

- 466S. VISUAL INSTRUCTION IN ATHLETICS (3) *Professor Conger*
 471S. HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION, AND ATHLETICS FOR THE SCHOOL ADMINISTRATOR (3) *Professor Lawther and Staff*
 Unit A. *Athletics in the Schools* (1)
 Unit B. *Health Education in the Schools* (1)
 Unit C. *Physical Education and Recreation in the Schools* (1)
 480. ADVANCED ANATOMY AND PHYSIOLOGY, APPLIED (3) *Professor Lucey*
 482, 482X. POSTURE EDUCATION IN THE SCHOOLS (3)
 488S. THE ADMINISTRATION OF PHYSICAL EDUCATION AND ATHLETICS FOR WOMEN (3) *Professor Haidt*
 489. INTRAMURAL ATHLETICS (3) *Professor Bischoff*
 490. INTRODUCTION TO TESTS AND MEASUREMENTS IN HEALTH AND PHYSICAL EDUCATION (3) *Professor Gross*
 491. ORGANIZATION AND ADMINISTRATION OF HEALTH AND PHYSICAL EDUCATION IN SCHOOLS (3) *Professor Lawther*

PHYSICS

PROFESSOR JOHN A. SAUER, M.S., Ph.D.

Head of the Department

507. THERMODYNAMICS (3) First and second laws, Carnot cycle, entropy, phase changes, low temperature phenomena.
 509. PHYSICS SEMINAR (1) Selected topics from current physical research critically examined and discussed. May be continued in successive semesters as Phys. 509a, 509b, 509c.
 512. SOLID STATE PHYSICS (3) Analytical treatment of physical properties of solids: crystal structure, X-ray diffraction, lattice vibrations, paramagnetism, ferromagnetism, ferroelectricity; electron theory of metals, semiconductors. Prerequisite: Phys. 530.
 517. STATISTICAL MECHANICS AND KINETIC THEORY (3) Maxwell-Boltzmann distribution, H-theorem, transport phenomena, ensembles, classical and quantum statistics. Prerequisite: Phys. 507.
 521. CRYSTAL STRUCTURE (3) Solution of the structure of crystals by X-ray methods. Available for major credit in either physics or chemistry. Prerequisite: Chem. 440 or Min. 460 or Phys. 461.
 522. ADVANCED CRYSTAL ANALYSIS (3) Continuation of Phys. 521, including the application of crystal structure studies to physical, chemical, and metallurgical problems. Available for major credit in either physics or chemistry.
 530-531. THEORETICAL PHYSICS (3 each) Application of higher mathematics to problems in various fields of physics. Prerequisite: Phys. 411 or 467.
 533. THEORY OF SOUND (3) Mathematical treatment of the theory of sound. Prerequisite: Phys. 530.

PHYSICS

553. NUCLEAR PHYSICS (3) Mathematical course in nuclear physics. Prerequisite: Phys. 562.
- 557-558. ELECTRICITY AND MAGNETISM (3 each) Treatment of the mathematical theory of electricity and magnetism. Prerequisite: Phys. 531.
560. ADVANCED PHYSICAL MEASUREMENTS (1-18) Offers opportunity for advanced work in various fields of physics.
561. DE BROGLIE WAVES AND QUANTUM MECHANICS (3) Introduction to modern interpretation of atomic structure and radiation phenomena, based upon the de Broglie and Schroedinger wave theory. Prerequisite: Phys. 531.
562. WAVE MECHANICS IN MODERN PHYSICS (3) Continuation of Phys. 561. Theory of atomic and simple molecular spectra, Zeeman and Stark effect, theories of metallic conductivity and thermionic emission, etc. Prerequisite: Phys. 561.
571. ATOMIC STRUCTURE (3) Recent work in atomic and subatomic physics.
572. SPECTROSCOPY (3) Atomic and molecular spectra, both emission and absorption methods of excitation, radiation and ionization potentials, spectral series, fine structure, spectra of ionized and stripped atoms.
575. PROBLEMS IN MODERN PHYSICS (1-3) Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 456.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. INTERMEDIATE ELECTRICITY AND MAGNETISM (4)
402. ELECTRONICS (4)
404. ELECTRONIC MEASUREMENTS (2-4)
406. NUCLEAR PHYSICS (3)
411. THEORETICAL MECHANICS (3)
412. THEORY OF THE SOLID STATE (3)
417. THE TEACHING OF PHYSICS (3)
420. INTERMEDIATE HEAT (3)
- 433S. INTERMEDIATE MECHANICS AND FLUID PHYSICS (3)
- 435S. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
- 437S. INTERMEDIATE HEAT, SOUND, AND LIGHT (3)
- 439S. ELEMENTARY SURVEY OF MODERN PHYSICS (3)
- 441S. DEMONSTRATION EQUIPMENT (3)
443. INTERMEDIATE ACOUSTICS (3)
444. MEASUREMENTS IN ACOUSTICS (2)
- 454, 454X. ATOMIC AND NUCLEAR PHYSICS (3)
456. ATOMIC AND NUCLEAR PHYSICS (3)
457. EXPERIMENTAL ATOMIC PHYSICS (2)
458. INTERMEDIATE OPTICS (4)
461. THEORETICAL MECHANICS (3)
467. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
- 473-474. BIOPHYSICS (3 each)
477. X-RAY ANALYSIS OF SOLIDS AND LIQUIDS (3)

POLITICAL SCIENCE

PROFESSOR HAROLD F. ALDERFER, M.A., Ph.D.

Head of the Department

- 500. SEMINAR IN POLITICAL SCIENCE (3-12) Subject to be announced.
- 505. SEMINAR IN ADVANCED AMERICAN GOVERNMENT (3-12)
- 508. RESEARCH IN PUBLIC ADMINISTRATION (3-12)
- 509. RESEARCH TECHNIQUES IN POLITICAL SCIENCE (3)
- 510. POLITICAL AND ADMINISTRATIVE PROBLEMS IN PENNSYLVANIA (3-6)
- 512. COMPARATIVE GOVERNMENT (3-12)
- 515. INTERNATIONAL RELATIONS (3-6)
- 517. INTERNATIONAL ORGANIZATION (3-6)
- 519. PUBLIC ADMINISTRATION (3-6)
- 521. POLITICAL THEORY (3-6)
- 535. GOVERNMENT REGULATION (3-6)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 411. AMERICAN POLITICAL THEORY (3)
- 413. GOVERNMENT AND POLITICS OF THE SOVIET UNION (3)
- 414. FOREIGN POLICY OF THE SOVIET UNION (3)
- 415. INTERNATIONAL ORGANIZATION (3)
- 416. INTERNATIONAL LAW (3)
- 417. MUNICIPAL GOVERNMENT (3)
- 419. PUBLIC ADMINISTRATION (3)
- 421. MODERN POLITICAL THEORIES (3)
- 424S. STATE GOVERNMENT IN THE UNITED STATES (3)
- 427. PUBLIC OPINION AND PROPAGANDA (3)
- 428. PENNSYLVANIA LOCAL GOVERNMENT (3)
- 429. PENNSYLVANIA LOCAL ADMINISTRATION (3)
- 431. ANCIENT AND MEDIEVAL POLITICAL THEORIES (3)
- 432. CURRENT POLITICAL TRENDS AND PROBLEMS IN THE UNITED STATES (3-9)
- 433. LABOR AND WELFARE LEGISLATION AND ADMINISTRATIVE PROBLEMS (3)
- 435. GOVERNMENT HOUSING, PLANNING, AND PUBLIC WORKS (3)
- 442. AMERICAN FOREIGN POLICY (3)
- 444. GOVERNMENT REGULATION (3)
- 445. ADMINISTRATIVE LAW (3)
- 446. JUDICIAL SYSTEMS (3)
- 450. GOVERNMENT AND FOREIGN POLICIES OF BRITAIN AND THE COMMONWEALTH (3)
- 456. GOVERNMENTS AND FOREIGN POLICIES OF LATIN AMERICA (3)
- 458. GOVERNMENTS AND FOREIGN POLICIES OF THE FAR EAST (3)
- 499X. FOREIGN STUDY IN GOVERNMENT (2-6)

PORTUGUESE

PORTUGUESE

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Head of the Department of Romance Languages

571. SEMINAR IN PORTUGUESE LITERATURE (3-6) Prerequisite: Port. 4.

POULTRY HUSBANDRY

PROFESSOR ERNEST W. CALLENBACH, M.S.

Head of the Department

502. ADVANCED POULTRY NUTRITION (2-4) Prerequisite: P.H. 3.
Professor Murphy
503. ADVANCED POULTRY FARM MANAGEMENT (2-4) Prerequisite: P.H. 8.
Professor Bressler
504. ADVANCED MARKET POULTRY AND EGGS (2-4) Prerequisites: P.H. 1,
7; Agr.Ec. 33 or 2 additional credits in poultry husbandry.
Professor Margolf
505. RESEARCH IN POULTRY HUSBANDRY (1-15 per semester) Prerequisite:
9 credits in poultry husbandry. *Professor Callenbach and Staff*
506. SEMINAR IN POULTRY HUSBANDRY (1-6)
Professor Callenbach and Staff

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

401. (Psy. 401). ANIMAL BEHAVIOR (3) *Professor Hale*
412. POULTRY BREEDING (3) *Professor Maw*

PSYCHOLOGY

PROFESSOR CLARENCE R. CARPENTER, M.A., Ph.D.

Head of the Department

500. SEMINAR: INTRODUCTION TO GRADUATE STUDY (0) Prerequisite:
new graduate student in psychology.
501. ADVANCED PSYCHOLOGY (3) Comprehensive study of general psychol-
ogy. Prerequisite: 9 credits in psychology. *Professor Lepley*
502. ADVANCED EDUCATIONAL PSYCHOLOGY (2-4) Psychological theories
and principles underlying educational theories and practices. Prerequisites:
Psy. 14 or 414; Ed. 31 or teaching experience. *Professor van Ormer*

503. **PHYSIOLOGICAL PSYCHOLOGY (2-6)** Correlations between structure and function of nervous system and human consciousness; laws and theories in fields of sensation, attention, association, affection, and thought. Prerequisite: 9 credits in psychology. *Professor DeCamp*
504. **COMPARATIVE PSYCHOLOGY (2-4)** Behavior from standpoint of phylogenetic growth and development; biological implications; comparison of different types of animals, including man. Prerequisite: 9 credits in psychology. *Professor Hale*
505. **RESEARCH PROBLEMS IN PSYCHOLOGY (1-15)** Prerequisite: 12 credits in psychology.
509. **ADVANCED THEORY OF LEARNING AND HABIT FORMATION (2-3)** Critical evaluation of major theories of learning: Hull, Guthrie, Tolman, Lewin. Application of learning theory to major problems in psychology. Prerequisite: Psy. 4 or 407 or 414. *Professor Grosslight*
510. **HISTORY OF PSYCHOLOGY (3)** Theoretical systems, experiments, and personalities in development of modern psychology until about 1920. Prerequisite: 9 credits in psychology. *Professor Carpenter*
511. **CONTEMPORARY AMERICAN PSYCHOLOGY (2-3)** Current systems or schools of psychology with comparative study and critical analysis; points of view as presented by recognized leaders. Prerequisite: 9 credits in psychology. *Professor Hall*
513. **EDUCATIONAL PSYCHOLOGY: DIFFERENTIAL (3)** Causes of differences in achievement and personality; psychological implications of methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*
514. **EDUCATIONAL PSYCHOLOGY: LEARNING (2)** Experimentally determined facts about the learning process; synthesis of main theories of learning; application of principles related to: motivation, practice, retention, transfer, meaning, and problem solving. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Professor van Ormer*
515. **ADVANCED STATISTICS IN PSYCHOLOGY AND EDUCATION (3)** Correlation theory and methods, discriminant function, and factor analysis; applications to mental test theory. Prerequisite: Psy. 415 or Ed. 574.
517. **PSYCHOLOGY OF ATTITUDES AND OPINIONS (3)** Acquisition and control of attitudes and opinions, including beliefs, convictions, biases, prejudices, and ideologies as determinants of action. Prerequisite: 18 credits in psychology, including Psy. 417, 422, 437.
518. **PROJECTS IN EXPERIMENTAL PSYCHOLOGY (2-4)** Individual experimental projects; seminars on experimental design and instrumentation. Prerequisite: Psy. 407.
522. **ADVANCED PSYCHOLOGICAL MARKETING RESEARCH TECHNIQUES (3)** Current literature; special questionnaire designs to test consumer reaction to products, advertising, and company policies from psychological standpoint; scale analysis; consumer motivation. Prerequisites: Psy. 15, 21, 422. *Professor Guest*

PSYCHOLOGY

525. **SAMPLING DESIGNS IN MARKET AND OPINION RESEARCH (3)** Techniques in selection of samples for accurate representation of human populations; special emphasis on probability sampling. Prerequisites: Psy. 15, 21, 422. *Professor Guest*
526. **ANALYSIS AND PRESENTATION OF MARKET AND OPINION RESEARCH DATA (3)** Classification and cross-tabulation of data as an aid in understanding research; analysis of opinion data by punch-card equipment. Prerequisites: Psy. 15, 21, 422. *Professor Guest*
527. **STATISTICAL INFERENCE AND EXPERIMENTAL DESIGN (3)** Probability theory, sampling distributions, analysis of variance and covariance, analysis of trend, nonparametric statistics, experimental design. Prerequisite: Psy. 415 or Ed. 574.
528. **OPINION RESEARCH ADMINISTRATION (3-6)** Practicum in planning, development of techniques, and administration of the sample survey. Prerequisites: Psy. 15, 21, 422. *Professor Guest*
529. (Ch.Fm. 529). **SEMINAR IN CHILD DEVELOPMENT (1-6)** Readings and reports on recent findings in child development. Prerequisites: Ch.Fm. 429, 430, or Psy. 411 or 425.
534. **APPLICATIONS OF PSYCHOLOGY IN BIO-MECHANICS (2)** Experimental studies of psychological factors affecting design and operation of machines. Prerequisites: Psy. 3 and 4, or 501. *Professor Corso*
- 535, 535X. **HUMAN DEVELOPMENT (2-3)** Psychological phases of human development throughout the life span; implications for school, community, and home. Prerequisite: 9 credits in psychology.
536. **RESEARCH METHODS AND PROBLEMS IN EDUCATIONAL AND DEVELOPMENTAL PSYCHOLOGY (1-6)** Prerequisites: Psy. 414 or 514; Ed. 470 or Psy. 415.
537. **SEMINAR IN INDUSTRIAL PSYCHOLOGY (3)** Prerequisite: Psy. 431.
538. **PSYCHOLOGY OF PERSONNEL DEVELOPMENT (3)** Industrial training in relation to psychological learning theory and experimental findings. Prerequisite: Psy. 431 or 414.
539. **MOTIVATION AND EMOTION (3)** Systematic status of instinct, drive, motive, will, purpose; methodology and results of physiological, experimental, and clinical investigation of basic drives. Prerequisite: Psy. 503.
540. **CLINICAL PSYCHOLOGY SEMINAR (1-6)** Seminar on current problems in clinical psychology. Prerequisite: Psy. 482.
541. **DYNAMICS OF HUMAN ADJUSTMENT (3)** Seminar on motivation of human behavior, frustration, and mechanisms of adjustment; normal behavior is stressed. Prerequisite: Psy. 437. *Professor Gorlow*
542. **PSYCHOPATHOLOGY (3)** Covers basic, developmental, human, experimental reactions, showing how normal and pathological character trends and deviations evolve; basic reasons for and applications of psychotherapeutic methods. Prerequisite: Psy. 412 or 437. *Professor Lott*

543. COUNSELING TECHNIQUES (2) Survey of psychotherapeutic methods; history, theory, and methods employed; case illustrations. Prerequisite: Psy. 482. *Professor Snyder*
544. INTERNSHIP IN PROFESSIONAL PSYCHOLOGY (1-9) Internship, under supervision of graduate faculty, in institution with practicing psychologists, where student is not regularly employed. Prerequisite: 3 semesters of graduate work in psychology.
Unit A. Comparative Psychology
Unit B. Educational and Developmental Psychology
Unit C. General Experimental Psychology
Unit D. Industrial and Business Psychology
Unit E. Social Psychology
Unit F. State Institutional Psychology
550. PSYCHOMETRICS: BINET (2) Measurement of intelligence by Stanford revision of the Binet-Simon technique; demonstrations, lectures; practice administering tests; observations of student by instructor.
551. PSYCHOMETRICS: POINT SCALES (2) Measurement of intelligence by individual nonverbal techniques: Arthur, Wechsler-Bellevue, and others; demonstrations, lectures, and practice administering tests under observation.
552. PSYCHOMETRICS: PRESCHOOL (2) Measurement by individual preschool scales: Merrill-Palmer, Minnesota, California First Year; demonstrations, lectures, and practice in administering tests under observation. Prerequisite: Psy. 551.
553. PSYCHOMETRICS: ADVANCED (2) Measurement of intelligence, social maturity, and other characteristics; demonstration, lectures, and practice in administering tests; observations by instructor. Prerequisite: Psy. 550.
Professor Bernreuter
555. PSYCHOMETRICS: RORSCHACH ADMINISTRATION (3) Introduction to theory of projective tests; supervised practice in administering and scoring of the Rorschach test. Prerequisite: Psy. 550 or 551.
Professors Guthrie and Gorlow
556. PSYCHOMETRICS: RORSCHACH INTERPRETATION (3) Study of current literature and supervised practice. Prerequisite: Psy. 555.
Professor Guthrie and Gorlow
557. PSYCHOMETRICS: ADVANCED PROJECTIVE TECHNIQUES (2-3) Survey of common projective techniques other than the Rorschach, with supervised practice. Prerequisite: Psy. 556.
Professors Guthrie and Gorlow
560. CLINICAL PRACTICUM (2-3) Applied experience in techniques of clinical psychology; case work in the Psychology Clinic. Prerequisites: Psy. 482, 550, 551.
561. CLINICAL PRACTICUM: ELEMENTARY SCHOOL (1-3) Experience in the Psychology Clinic and public schools in learning and adjustment problems; diagnosis and remedial work; pertinent school laws and practices. Prerequisites: Psy. 560 and Ed. 70, or Ed. 432g or 470.

PSYCHOLOGY

562. CLINICAL PRACTICUM: VOCATIONAL GUIDANCE (1-3) Practical experience in the Psychology Clinic on high school, college, and adult vocational guidance cases; staff meetings; seminar on techniques and materials. Prerequisite: Psy. 560 or Ed. 502.
563. CLINICAL PRACTICUM: MARITAL COUNSELING (1-3) Experience in the Psychology Clinic on premarital and marital adjustment; seminar on techniques of adjustment and development of sexual and emotional maturity in marriage. Prerequisite: Psy. 560. *Professor Adams*
- 564, 564X. CLINICAL PRACTICUM: PERSONAL ADJUSTMENT COUNSELING (2-3) Advanced practicum with experience in counseling of personal adjustment problems referred to the Psychology Clinic. Prerequisite: Psy. 565. *Professor Snyder*
565. CLINICAL PRACTICUM: NONDIRECTIVE COUNSELING (3) Practical experience in application of the nondirective method, along with systematic theoretical study of the method. Prerequisites: Psy. 543, 560. *Professor Snyder*
566. CLINICAL PRACTICUM: HYPNOTHERAPY (1-3) Practical experience in the Psychology Clinic in use of hypnotherapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.
567. CLINICAL PRACTICUM: PLAY THERAPY (1-3) Practical experience in the Psychology Clinic in use of play therapy with young children; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.
568. CLINICAL PRACTICUM: GROUP THERAPY (2) Practical experience in the Psychology Clinic in use of group methods for treatment of personal maladjustments; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565. *Professor Gorlow*
569. CLINICAL PRACTICUM: ADVANCED NONDIRECTIVE (2) Practical experience in the Psychology Clinic in advanced nondirective therapy techniques; staff meetings; case conferences. Prerequisite: Psy. 565. *Professor Snyder*
574. MENTAL DEFICIENCY (3) Causes of mental deficiency; diagnosis, training, and care of mental defectives. Prerequisite: Psy. 414 or 482.
590. SEMINAR: ADVANCED (1-2) Prerequisite: Psy. 500.
591. SEMINAR ON TEACHING PSYCHOLOGY (1-3) Objectives and content of psychology; organization and presentation of material; teaching aids and techniques. *Professor Hall*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

400. HONORS COURSE IN PSYCHOLOGY (2-6)
401. (P.H. 401). ANIMAL BEHAVIOR (3)

Professor Hale

P S Y C H O L O G Y

403. INTRODUCTORY PHYSIOLOGICAL PSYCHOLOGY (3)
 407. INTERMEDIATE EXPERIMENTAL PSYCHOLOGY (3) *Professor Lepley*
 411, 411X. PSYCHOLOGY OF THE PRESCHOOL CHILD (3) *Professor van Ormer*
 412, 412X. ABNORMAL PSYCHOLOGY (3) *Professor DeCamp*
 414, 414X. INTERMEDIATE EDUCATIONAL PSYCHOLOGY (2-3) *Professor Thevaos*
 415, 415X. INTERMEDIATE STATISTICS IN PSYCHOLOGY AND EDUCATION (3)
 417. SOCIAL PSYCHOLOGY (2-3) *Professor Carpenter*
 418. MEASUREMENT OF PERSONALITY (3) *Professor Bernreuter*
 419. GUIDANCE AND EDUCATION IN SEXUAL AND MARITAL ADJUSTMENT (3) *Professor Adams*
 420. APPLIED SOCIAL PSYCHOLOGY (3) *Professor Carpenter*
 422. PSYCHOLOGICAL METHODS OF MEASURING THE REACTIONS OF THE PUBLIC (3) *Professor Guest*
 423. TEST CONSTRUCTION AND STANDARDIZATION (2-3)
 424, 424X. PSYCHOLOGICAL TECHNIQUES IN PUBLIC PERSONNEL ADMINISTRATION (3) *Professor Adams*
 425, 425X. PSYCHOLOGY OF THE ELEMENTARY SCHOOL CHILD (2-3) *Professor van Ormer*
 426, 426X. ADOLESCENCE (2-3) *Professor Thevaos*
 427. PSYCHOLOGICAL PRINCIPLES IN ADVERTISING (3) *Professor Guest*
 428. OPINION RESEARCH LABORATORY (3) *Professor Guest*
 429. PSYCHOLOGY OF COMMUNICATION (3)
 431, 431X. INDUSTRIAL PSYCHOLOGY (3) *Professor Smith*
 436, 436X. MENTAL HYGIENE IN SCHOOLS (3)
 437, 437X. PSYCHOLOGY OF ADJUSTMENT (3) *Professor Gorlow*
 438. THEORY OF PERSONALITY (3) *Professor Grosslight*
 440. PSYCHOLOGY PROJECTS (1-6)
 441. INDUSTRIAL MOTIVATION AND MORALE (3)
 445. (Ch.Fm. 445). DEVELOPMENT THROUGHOUT ADULTHOOD (3)
 450, 450X. MEASUREMENT OF ABILITIES (3)
 482. INTRODUCTION TO CLINICAL PSYCHOLOGY (3) *Professor Snyder*

PUBLIC UTILITIES

PROFESSOR ARTHUR H. WAYNICK, M.S., Sc.D.

Head of the Department of Electrical Engineering

The following course may be taken for graduate credit under the restrictions in force:

421. ELECTRIC UTILITIES (3) *Professor Powell*

RECREATION

Consult PROFESSOR FRED M. COOMBS, M.A.

530. CAMP ADMINISTRATION (3) Camp site development; staff selection, training, and supervision; development of objectives and program planning; values inherent in outdoor and camping education. Prerequisite: Recr. 430.
Professor Coombs
533. RECREATION STUDIES, SURVEYS, AND APPRAISALS (3) Types, purposes, and methods of conducting recreation studies and surveys; procedures in appraisal of community recreation. Prerequisite: Ph.Ed. 530.
Professor Coombs
560. ADMINISTRATIVE PROBLEMS OF RECREATION (3) Administrative problems in park and recreation departments; departmental organization, finance, personnel, facilities, program, and public relations. Prerequisite: Recr. 465.
Professor Coombs

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 430. CAMPING AND OUTDOOR EDUCATION (3) | <i>Professor Coombs</i> |
| 432. RECREATION IN INDUSTRY (3) | <i>Professor Coombs</i> |
| 434. RECREATION AREAS AND FACILITIES (3) | <i>Professor Coombs</i> |
| 456, 456X. SOCIAL RECREATION (3) | <i>Professor White</i> |
| 461, 461X. COMMUNITY RECREATION (1 per unit) | <i>Professor Coombs</i> |
| Unit A. <i>Programs of the Rural Community</i> (1) | |
| Unit B. <i>Programs of the Urban Community</i> (1) | |
| Unit C. <i>Programs of Large Municipalities</i> (1) | |
| 462. RECREATION FOR THE HANDICAPPED (3) | <i>Professor White</i> |
| 465, 465X. ADMINISTRATION OF RECREATION (3) | <i>Professor Coombs</i> |

*RURAL SOCIOLOGY

PROFESSOR MACKLIN E. JOHN, M.S., Ph.D.

Head of the Department of Agricultural Economics and Rural Sociology

551. RURAL SOCIOLOGY SEMINAR (1-6) Prerequisite: 6 credits in rural sociology, sociology, or psychology.
552. ADVANCED RURAL SOCIOLOGY (3) Structure and functioning of rural society.
553. SEMINAR IN RURAL SOCIOLOGICAL RESEARCH (1-6) Continuation of R. Soc. 552. Functioning of rural society; research dealing with the subject reviewed and evaluated.

*Credit in rural sociology will also be given for Agr.Ec. 505 and 525.

RURAL SOCIOLOGY

554. ADVANCED RURAL SOCIAL WELFARE (3) Analysis of welfare techniques and their application to rural situations. Prerequisites: R.Soc. 11; Psy. 2 or R.Soc. 459. *Professor Mather*

555. THE RURAL CHURCH (3) The rural church as a social institution; its relation to the community; the church in "problem" areas; effects of population trends on the program of the rural church; use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology. *Professor Mather*

557. THE DEVELOPMENT OF THE RURAL COMMUNITY (3) Origin and evolution of the rural community under different geographic and cultural conditions. Prerequisites: R.Soc. 11 or Soc. 1; R.Soc. 452. *Professor Mather*

559. ADVANCED RURAL SOCIAL PSYCHOLOGY (3) Application of social psychological principles to treatment of rural problems. Prerequisites: R.Soc. 11, Psy. 2. *Professor Brown*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

452. RURAL ORGANIZATION (3) *Professor Brown*

454. RURAL SOCIAL WELFARE (3) *Professor Mather*

456. RURAL STANDARDS OF LIVING (3) *Professor Mather*

459. RURAL SOCIAL PSYCHOLOGY (3) *Professor Brown*

RUSSIAN

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Head of the Department of Romance Languages

The following courses may be taken for graduate credit under the restrictions in force:

401. STUDIES IN RUSSIAN LITERATURE (3-6)

425. PUSHKIN (3)

426. DOSTOEVSKI (3)

427. TOLSTOY (3)

SOCIOLOGY

PROFESSOR ROBERT E. CLARK, M.A., Ph.D.

Acting Head of the Department

503. SEMINAR IN SOCIAL PSYCHOLOGY (3-9) Investigation of theories, methods, and empirical data of social psychology, with particular reference to such problems as relations between personality and culture, social and personal disorganization, development of role behavior, and conception of the self. *Professor Coutu*

510. FIELD WORK IN SOCIOLOGY (1-6)

SOCIOLOGY

513. SEMINAR IN SOCIOLOGICAL RESEARCH PROBLEMS: A. RESEARCH TECHNIQUES; B. CURRENT RESEARCH (3-6) Prerequisites: Soc. 413; 3 credits in statistics. *Professors John and Bernard*
515. SEMINAR IN COMMUNITY STUDIES (3) *Professor Bernard*
516. SEMINAR IN SOCIOLOGICAL THEORY (3-9) *Professors Green and Blizzard*
523. POPULATION PROBLEMS (1-9) *Professor Clark*
525. SEMINAR IN SOCIOLOGY (1-9) Research problems in theoretical and applied sociology.
530. RESEARCH ON MARRIAGE AND THE FAMILY (3) Training in methods and techniques of research in family relations. Under the guidance of the instructor, experimental, statistical, and comparative studies are carried out, individually or co-operatively. Prerequisite: 3 credits of previous work in this field. *Professor Bernard*
572. METHODS OF SAMPLING (3) Application of sampling techniques to sociological research. Prerequisite: Soc. 471. *Professor Clark*
- In addition to these courses, the following may be taken for graduate credit under the restrictions in force:*
401. SOCIAL INSTITUTIONS (3) *Professor Green*
403. ADVANCED SOCIAL PSYCHOLOGY (3) *Professor Coutu*
- 405S. SOCIAL PROBLEMS (3)
413. METHODS AND TECHNIQUES OF SOCIAL RESEARCH (1-6) *Professor Bernard*
418. THE DEVELOPMENT OF SOCIAL THOUGHT (3)
423. POPULATION RESEARCH (3) *Professor Clark*
424. SOCIAL CHANGE (3) *Professor Abramson*
425. CONTEMPORARY SOCIOLOGICAL THEORY (3) *Professor Green*
426. INTRODUCTION TO PUBLIC WELFARE (3) *Professor Mather*
- 427S. FAMILY CASE WORK (6)
429. SOCIAL STRATIFICATION (3)
431. COMMUNICATION AND MASS SOCIETY (3) *Professor Abramson*
470. USE OF STATISTICS IN SOCIOLOGY (3) *Professor Clark*
- 495S. (Ch.Fm. 495S, Ed. 495S, Hl.Ed. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3)
- 499X. FOREIGN STUDY IN SOCIOLOGY (2-6)

SPANISH

PROFESSOR FRANKLIN B. KRAUSS, A.M., Ph.D.

Head of the Department of Romance Languages

- *1G. ELEMENTARY SPANISH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.

*No graduate credit is given for this course.

- 538. THE GENERATION OF 1898 (3) Principal works and intellectual trends of the period with special emphasis on Unamuno.
- 544. NEOCLASSICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Neoclassic movement in Italy, France, Spain, and Portugal.
- 545. ROMANTICISM IN THE ROMANCE LITERATURES (3) Nature and development of the Romantic movement in Italy, France, Spain, and Portugal.
- 546. MEDIEVAL ROMANCE LITERATURES (3) Nature and development of medieval literature and thought, with particular reference to Italy, France, Spain, and Portugal.
- 547. REALISM, WITH PARTICULAR REFERENCE TO ROMANCE LITERATURE (3)
- 549. MODERNISMO (3) The movement, its antecedents, and its followers, with special emphasis on Rubén Darío.
- 551. ROMANCE PHILOLOGY (3) Historical development of the Romance languages.
- 552. MEDIEVAL SPANISH LITERATURE (3) Familiarizes the student with Old Spanish texts.
- 561-562. SPANISH DRAMA PREVIOUS TO LOPE DE VEGA (3 each) Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed.
- 565. LOPE DE VEGA (3)
- 566. LOPE DE VEGA'S FOLLOWERS (3)
- 567-568. CERVANTES AND HIS WORKS (3 each)
- 571. SEMINAR IN SPANISH LITERATURE (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.
- 572. SEMINAR IN SPANISH LITERATURE (3) Continuation of Sp. 571.
- 574. METHODS AND BIBLIOGRAPHY IN ROMANCE LANGUAGES AND LITERATURES (1-2)

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

- 401. THE GOLDEN AGE (3)
- 402. DRAMA OF THE GOLDEN AGE (3)
- 403. DON QUIXOTE (3)
- 404. OLD SPANISH LANGUAGE AND LITERATURE (3)
- 405. SPANISH DRAMA OF THE 19TH CENTURY (3)
- 406. CONTEMPORARY SPANISH DRAMA (3)
- 407. THE SPANISH NOVEL OF THE 19TH CENTURY (3)
- 408. THE CONTEMPORARY SPANISH NOVEL (3)
- 409, 409X. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)
- 410. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)

SPANISH

- 411. MEXICO: ITS LANGUAGE AND LITERATURE (3)
- 412. ARGENTINA: ITS LANGUAGE AND LITERATURE (3)
- 415. MODERN SPANISH LYRIC POETRY (3)
- 417. SPANISH LITERATURE IN THE ROMANTIC PERIOD (3)
- 421. THE TEACHING OF ROMANCE LANGUAGES (3)
- 471. PROBLEMS IN SPANISH LITERATURE (3-6)
- 490. ADVANCED COMPOSITION AND CONVERSATION (3)
- 496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

SPEECH

PROFESSOR ROBERT T. OLIVER, M.A., Ph.D., LL.D.

Head of the Department

- 500. SEMINAR IN AMERICAN ORATORY (2-4) History of American oratory, with application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Spch. 200.
Professor Joseph O'Brien
- 505. HISTORICAL DEVELOPMENT OF SPEECH THEORY (2-4) Survey of ancient, medieval, and modern theories of public address in relation to currently accepted speech theories.
Professor DeBoer
- 508. SEMINAR IN BRITISH ORATORY (2-4) History of British oratory; application of critical standards to the work of selected orators. *Professor Fife*
- 510. SEMINAR IN METHODS OF TEACHING SPEECH (2-4) Curriculum construction, media, and methods in high school and college. Prerequisite: 6 credits in speech including Spch. 200.
Professor Joseph O'Brien
- 520. SEMINAR IN SPEECH SCIENCE (2-4) Seminar in physical and physiological bases of speech and voice; introduction to laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology.
Professor Brubaker
- 540. SEMINAR IN THE PROBLEMS OF RADIO (3) Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 credits in speech including Spch. 200, 300; 425 or 435.
Professor Nelson
- 550. SEMINAR IN ORAL PERSUASION (2-4) Theory and devices of persuasion; analysis of persuasive discourse. Prerequisite: 6 credits in speech including Spch. 200.
Professor Oliver
- 555. SPEECH COMMUNICATION: PROBLEMS AND PRINCIPLES (2-4) Prevalent theories of speech influence.
Professor Oliver
- 560. PUBLIC ADDRESS (2-4) Discussion and criticism of speech outline, manuscript, content, composition, and delivery. Prerequisite: 6 credits in speech including Spch. 200.
Professor Schug

575. RESEARCH PROBLEMS IN SPEECH (1-12) Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

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| 400, 400X. TEACHING OF SPEECH (3) | Professor Schug |
| 401. PROBLEMS, METHODS, AND AREAS IN SPEECH (3) | Professor Carter |
| 402. INTRODUCTION TO GENERAL SEMANTICS (3) | Professor Carter |
| 410. ENGLISH PHONETICS AND PRONUNCIATION (3) | Professor Brubaker |
| 411a,b,cS. SPEECH SCIENCE AND SPEECH ARTS (1-3) | |
| 412. SPEECH COMPOSITION (3) | Professor DeBoer |
| 415. EXPERIMENTAL AND APPLIED PHONETICS (3) | |
| 416. METHODS OF COACHING DEBATE (3) | Professor Harold O'Brien |
| 425. ADVANCED PRINCIPLES OF RADIO SPEECH (3) | Professor Mackey |
| 431. ANATOMY AND PHYSIOLOGY OF THE EAR AND VOCAL MECHANISMS (3) | |
| | Professor Brubaker |
| 435. RADIO ORGANIZATION (3) | Professor Nelson |
| 437. PRINCIPLES OF TELEVISION SPEECH (3) | Professor Nelson |
| 445. SPEECH AS A MEDIUM OF INTERNATIONAL RELATIONS (3) | |
| | Professor Oliver |
| 450. DISCUSSION TECHNIQUES (3) | Professor Joseph O'Brien |

SPEECH EDUCATION

Consult PROFESSOR EUGENE T. McDONALD, M.Ed., D.Ed.

525. SEMINAR IN CLINICAL SPEECH PATHOLOGY (3-9) Prerequisites: Sph. Ed. 436, 442.
Unit A. Cleft Palate
Unit B. Cerebral Palsy
Unit C. Aphasia
530. SEMINAR IN AUDIOLOGY (2-4) Review of theories of hearing, and review of related physiological and psychological researches. Prerequisite: Sph.Ed. 434.
537. ADVANCED CLINICAL PRACTICE IN SPEECH CORRECTION (1-9) Prerequisites: Sph.Ed. 437, 442.
Unit A. Diagnostic Procedures (1-3)
Unit B. Treatment Procedures (1-6)
540. ARTICULATION DISABILITIES (3) Speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisites: Sph.Ed. 437, 442.
541. THE VOICE AND ITS DISORDERS (3) Physical, physiological, and psychological bases of voice production; causes, nature, and symptoms of its disorders; current clinical methods in voice improvement. Prerequisites: Sph.Ed. 437, 442.

SPEECH EDUCATION

542. STUTTERING AND ALLIED DISORDERS (3) Modern theories of causes of disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisites: Sph.Ed. 437, 442.
543. DIAGNOSTIC PROCEDURES IN CLINICAL SPEECH (3) Clinical instrumentation; case history taking; examination procedures and materials used in diagnosing speech disabilities; interpretation of findings; report preparation. Prerequisites: Sph.Ed. 437, 442.

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

430. HEARING PROBLEMS AND THE TESTING OF HEARING (3)
434. AUDIOMETRY AND HEARING AIDS (3)
435. CLINICAL PRACTICE WITH THE HEARING HANDICAPPED (1-6)
 Unit A. Audiologic Evaluation and the Selection of Hearing Aids (1-4)
 Unit B. Auditory Training and Speech Reading (1-4)
436. INTRODUCTION TO SPEECH CORRECTION (3)
437. CLINICAL PRACTICE IN SPEECH CORRECTION (1-3)
439X. FUNDAMENTALS OF SPEECH EDUCATION (3)
439aX. METHODS IN SPEECH EDUCATION (3)
440, 440X. SPEECH EDUCATION FOR THE CLASSROOM TEACHER (2-3)
441S. CURRENT PROBLEMS IN SPEECH AND HEARING (1-6)
442. SPEECH PATHOLOGY (3)
443. METHODS IN AUDITORY TRAINING AND SPEECH READING (3)
445. THE PUBLIC SCHOOL SPEECH CORRECTION PROGRAM (3)

VETERINARY SCIENCE

PROFESSOR ALFRED L. BORTREE, M.S., D.V.M.

Head of the Department

The following courses may be taken for graduate credit under the restrictions in force:

400. VETERINARY ANATOMY AND PHYSIOLOGY (3)
401. INFECTIOUS DISEASES OF DOMESTIC ANIMALS (2)

ZOOLOGY

PROFESSOR BERTIL G. ANDERSON, M.S., Ph.D.

Head of the Department of Zoology and Entomology

508. ADVANCED PARASITOLOGY (3) Advanced work on the structure, life cycle, and control of parasites. Prerequisites: Ent. 2, Zool. 432.
Professor Zeliff
509. TECHNIQUES IN WILDLIFE MANAGEMENT (3) Preparing study mounts, census making, management area mapping, methods of collecting

data, and determining food habits from stomach contents. Prerequisite: Zool. 546. *Professor English*

512. SEMINAR (1) Review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology. *Professor English*

514. SPECIAL TOPICS IN ZOOLOGY (3) Individual problems in any field of zoology, with or without experimental work. Prerequisite: Zool. 26.

532S. ANIMAL PARASITES (3) Structure, life cycle, and control. Prerequisite: Zool. 432.

541. COMPARATIVE PHYSIOLOGY (3) Dynamics of vital processes as shown in members of the animal kingdom. Prerequisites: Zool. 26, A.B.Ch. 1, A.B.Ch. 425 or Zool. 437. *Professor Frings*

546. THE THEORY OF GAME MANAGEMENT (4) Fundamental principles underlying management of wild game birds and mammals; co-ordination of such management with various land uses; planning preserves and other land areas. Prerequisites: Zool. 408, 420. *Professor English*

547S. WILDLIFE MANAGEMENT (3) Basic principles concerned with management of game birds and game mammals. Prerequisite: Zool. 420. *Professor English*

551. FISHERIES MANAGEMENT (3) Basic principles underlying management of inland waters for fish production. Prerequisite: Zool. 450.

581. ADVANCED INVERTEBRATE ZOOLOGY (3) Morphology, physiology, taxonomy, and life histories of invertebrate animals. *Professor Frings*

583. GENERAL ENDOCRINOLOGY (2) Anatomy and physiology of the organs of internal secretion; role of hormones in metabolism and development. *Professor Anthony*

587. BIOLOGY OF SEX (2) Hereditary and embryological aspects, problems in gonadal differentiation, cyclic reproductive phenomena, actions of the hormones. *Professor Anthony*

In addition to these courses, the following may be taken for graduate credit under the restrictions in force:

408. MAMMALOGY (4) *Professor English*

410. GENERAL LIMNOLOGY (3)

415. THE LITERATURE OF ZOOLOGY (1) *Professor B. G. Anderson*

416. THE METHODS OF RESEARCH IN ZOOLOGY (2) *Professor B. G. Anderson*

417. INVERTEBRATE FAUNISTICS (4) *Professor Frings*

418S. FIELD ORNITHOLOGY (3) *Professor Wood*

419S. GENERAL ANIMAL ECOLOGY (3) *Professor Blackburn*

420. GAME BIRDS (3) *Professor English*

421. COMPARATIVE ANATOMY OF VERTEBRATES (4) *Professor Cheng*

432. HUMAN PARASITOLOGY (3) *Professor Zelif*

436. PROTOZOOLOGY (3) *Professor Zelif*

437. HISTOLOGY (4) *Professor Newman*

ZOOLOGY

- 440. EMBRYOLOGY (4)
- 444. ZOOLOGICAL PROBLEMS (1-6)
- 448. ORNITHOLOGY (3)
- 450. ICHTHYOLOGY (4)
- 461. ANIMAL PARASITOLOGY (3)

Professor Newman

Professor Wood



THE PENNSYLVANIA STATE UNIVERSITY
GRADUATE SCHOOL ANNOUNCEMENT
STATE COLLEGE, PENNSYLVANIA

THE PENNSYLVANIA STATE UNIVERSITY BULLETIN



GRADUATE SCHOOL
ANNOUNCEMENT ~ 1956-1957

PENN STATE COLLECTION

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THE PENNSYLVANIA STATE
UNIVERSITY BULLETIN

*GRADUATE SCHOOL
ANNOUNCEMENT*

1956-1957



UNIVERSITY PARK,
PENNSYLVANIA

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GRADUATE SCHOOL CALENDAR

SUMMER SESSIONS 1956

JUNE 1956

- 11 Monday—Registration for Inter-Session 8 a.m. to 12 noon
- 11 Monday—Inter-Session Classes Begin 2 p.m.
- 29 Friday—Inter-Session Ends 4:50 p.m.

JULY

- 2 Monday—Registration for Main Summer Session
- 3 Tuesday—Main Summer Session Classes Begin 8 a.m.
- 4 Wednesday—Independence Day Recess
- 14 Saturday—Last Date for an August Graduate to Deliver Doctoral Thesis to Committee
- 21 Saturday—Last Date for an August Graduate to Deliver Master's Thesis to Preceptor
- 21 Saturday—Last Date for Final Oral Doctoral Examination for August Graduates
- 21 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 28 Saturday—Theses Due in Graduate School Office by 12 noon
- 30 Monday—Foreign Language Examinations for Doctorate

AUGUST

- 10 Friday—Main Summer Session Ends 4:50 p.m.
- 11 Saturday—Main Summer Session Graduation Exercises
- 13 Monday—Registration for Post-Session 8 a.m. to 12 noon
- 13 Monday—Post-Session Classes Begin 2 p.m.
- 31 Friday—Post-Session Ends 4:50 p.m.

FALL SEMESTER 1956

SEPTEMBER 1956

- 12-15 Wednesday to Saturday—Fall Semester Registration
- 17 Monday—Fall Semester Classes Begin 8 a.m.
- 28 Friday—Convocation of the Graduate School 7:30 p.m.
- 29 Saturday Noon—Last Date for Students to Add Courses

OCTOBER

- 13 Saturday Noon—Last Date for Students to Drop Courses
- 18 Thursday—Graduate Faculty Meeting 4:10 p.m.

NOVEMBER

- 5 Monday—Foreign Language Examination for Doctorates
- 15 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 21 Wednesday—Thanksgiving Recess Begins 11:50 a.m.
- 26 Monday—Thanksgiving Recess Ends 8 a.m.

DECEMBER

- 19 Wednesday—Christmas Recess Begins 5 p.m.
- 29 Saturday—Last Date for a January Graduate to Deliver Doctoral Thesis to Committee

JANUARY 1957

- 3 Thursday—Christmas Recess Ends 8 a.m.
- 5 Saturday—Last Date for a January Graduate to Deliver Master's Thesis to Preceptor
- 5 Saturday—Last Date for Final Oral Doctoral Examination for January Graduates
- 5 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 12 Saturday Noon—Theses Due in Graduate School Office
- 16 Wednesday—Fall Semester Classes End 5 p.m.
- 17 Thursday—Fall Semester Examinations Begin 8 a.m.
- 25 Friday—Fall Semester Ends 5:30 p.m.
- 28 Monday—Fall Semester Graduation Exercises

SPRING SEMESTER 1957

JANUARY 1957

Jan. 30- }
Feb. 2 } Wednesday to Saturday—Spring Semester Registration

FEBRUARY

- 4 Monday—Spring Semester Classes Begin 8 a.m.
- 16 Saturday Noon—Last Date for Students to Add Courses
- 21 Thursday—Graduate Faculty Meeting 4:10 p.m.

MARCH

- 2 Saturday Noon—Last Date for Students to Drop Courses
- 4 Monday—Foreign Language Examinations for Doctorates
- 21 Thursday—Graduate Faculty Meeting 4:10 p.m.

APRIL

- 17 Wednesday—Spring Recess Begins 11:50 a.m.
- 24 Wednesday—Spring Recess Ends 1:10 p.m.

MAY

- 11 Saturday—Last Date for a June Graduate to Deliver Doctoral Thesis to Committee
- 16 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 18 Saturday—Last Date for a June Graduate to Deliver Master's Thesis to Preceptor
- 18 Saturday—Last Date for Final Oral Doctoral Examination for June Graduates
- 18 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 25 Saturday—Spring Semester Classes End 11:50 a.m.
- 25 Saturday Noon—Theses Due in Graduate School Office
- 25 Saturday—Spring Semester Examinations Begin 1:20 p.m.
- 30 Thursday—Memorial Day Recess

JUNE

- 5 Wednesday—Spring Semester Ends 12:30 p.m.
- 8 Saturday—Commencement Day

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HAROLD K. FLEMING, M.S. (Penn State)	<i>Pomology</i>
KENT FORSTER, Ph.D. (Pennsylvania)	<i>European History</i>
DONALD E. H. FREAR, Ph.D. (Penn State)	<i>Agricultural and Biological Chemistry</i>
CYRUS E. FRENCH, Ph.D. (Penn State)	<i>Animal Nutrition</i>
JOHN F. FRIESE, M.S. (Wisconsin)	<i>Industrial Arts Education</i>
HUBERT W. FRINGS, Ph.D. (Minnesota)	<i>Zoology</i>
ORRIN FRINK, Ph.D. (Columbia)	<i>Mathematics</i>
STUART W. FROST, Ph.D. (Cornell)	<i>Economic Entomology</i>
RALPH O. GALLINGTON, D.Ed. (George Washington)	<i>Industrial Arts Education</i>
RALPH J. GARBER, Ph.D. (Minnesota)	<i>Agronomy</i>
THEODORE J. GATES, M.A. (Penn State)	<i>English Composition</i>
JAMES GEMMELL, D.Ed. (N.Y.U.)	<i>Economics and Business Education</i>
JOHN J. GIBBONS, Ph.D. (Illinois)	<i>Physics</i>
GERALD K. GILLAN, Ph.D. (Missouri), P.E.	<i>Civil Engineering</i>
MAURICE S. GJESDAHL, M.S. (Lehigh)	<i>Mechanical Engineering</i>
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WILLIAM F. HALL, Ph.D. (Cornell)	<i>Agricultural Education</i>
PHILIP F. HALLOCK, M.S. (Penn State), R.A.	<i>Architecture</i>
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BRICE HARRIS, Ph.D. (Harvard)	<i>English Literature</i>
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	<i>Home Economics Education and Home-Community Relationships</i>
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JOHN A. HIPPLE, Ph.D. (Princeton)	
	<i>Geophysics; Director of the Mineral Industries Experiment Station</i>
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DOROTHY HOUGHTON, Ph.D. (Columbia)	<i>Home Economics</i>
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LAWRENCE L. HUBER, Ph.D. (Ohio State)	<i>Agronomy</i>
MERWIN W. HUMPHREY, M.F. (Yale)	<i>Forestry</i>
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A. W. HUSSMAN, Dr.Ing. (Berlin), P.E.	<i>Engineering Research</i>
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Dairy Science
Engineering Research
Engineering Mechanics
Soil Technology
Geochemistry
Engineering Research
Fuel Technology
American History
Physics
Sanitary Engineering
Mathematics
Latin
Botany
Petrology and Sedimentation
Industrial Education
Horticulture
Physical Education
Marketing
Finance
Psychology
Romance Languages
Plant Pathology
Metallurgy
Education
English Literature
Psychiatrist
Foods and Nutrition
Art Education
English Composition
Journalism
Poultry Husbandry
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English Literature
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Soil Technology
Engineering Research
Geography
Education
Agricultural and Biological Chemistry
Mining Engineering
Anthropology
Child Development and Family Relationships
Philosophy

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JAMES H. MOYER, D.Ed. (Columbia)	<i>Education</i>
ERWIN W. MÜLLER, D.Eng. (Technical University, Berlin)	<i>Physics</i>
GEORGE E. MURPHY, D.Ed. (Stanford)	<i>Education</i>
ROBERT R. MURPHY, Ph.D. (Penn State)	<i>Poultry Husbandry</i>
H. BURTON MUSSER, B.S. (Penn State)	<i>Agronomy</i>
HANS NEUBERGER, D.Sc. (Hamburg)	<i>Meteorology</i>
FRANK S. NEUSBAUM, M.A. (Penn State)	<i>Dramatics</i>
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GORDON H. PRITHAM, Ph.D. (Penn State)	<i>Physiological Chemistry</i>
ALFRED G. PUNDT, Ph.D. (Columbia)	<i>European History</i>
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ROBERT R. ROBINSON, Ph.D. (West Virginia)	<i>Soil Technology</i>
ARTHUR ROSE, Ph.D. (Cincinnati)	<i>Chemical Engineering</i>
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JOSEPH J. RUBIN, Ph.D. (Yale)	<i>American Literature</i>
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JOHN A. SAUER, Ph.D. (Cambridge)	<i>Physics</i>
HAROLD K. SCHILLING, Ph.D. (Iowa), D.Sc.	<i>Physics</i>
CLAYTON H. SCHUG, M.A. (Ohio State)	<i>Public Speaking</i>
PAUL H. SCHWEITZER, Dr.Ing. (Dresden), P.E.	<i>Engineering Research</i>
JOHN G. SEELEY, Ph.D. (Cornell)	<i>Floriculture</i>
RALPH P. SEWARD, Ph.D. (Brown)	<i>Chemistry</i>
AMOS J. SHALER, Sc.D. (M.I.T.)	<i>Metallurgy</i>

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 HOWARD B. SPRAGUE, Ph.D. (Rutgers)
 VANCE G. SPRAGUE, Ph.D. (Wisconsin)
 EARL B. STAVELY, E.E. (Penn State)
 HERBERT STEINER, Ph.D. (Zurich)
 ROBERT W. STONE, Ph.D. (Iowa State)
 RANDALL S. STOUT, Ph.D. (Pittsburgh)
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 A. BRUCE SUTHERLAND, Ph.D. (Pennsylvania)
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 WILLA C. TAYLOR, M.A. (N.Y.U.)
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 WAYNE WEBB, Ph.D. (Iowa)
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 WILLIAM L. WERNER, M.A. (Penn State)
 CLIFFORD C. WERNHAM, Ph.D. (Cornell)
 WOLDEMAR WEYL, Dr.Ing. (Aachen)
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 MARSH W. WHITE, Ph.D. (Penn State)
 WALLACE E. WHITE, Ph.D. (Yale)
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 GEORGE F. WISLICENUS, Ph.D. (California Tech.), P.E.
 HAROLD P. ZELKO, M.A. (Ohio State), LL.B.
 P. THOMAS ZIEGLER, M.S. (Penn State)

Wildlife Management
Mathematics
German and Comparative Literature
Chemistry
Psychology
Family Relationships
Psychology
Mechanical Engineering
Physical Education
Agronomy
Agronomy (part-time)
Electrical Engineering
German
Bacteriology
Public Finance
Management
Phytochemistry
English Literature
Paleontology
Animal Nutrition
Business Law
Electrical Engineering
Elementary Education
Music Education
Physical Education
Anatomy and Physiology
Agricultural and Biological Chemistry
Geochemistry
Education
Psychology
Botany
Agronomy
Transportation
Electrical Engineering
Education
Physics
Counselor Education
American Literature
Plant Pathology
Glass Technology
Insurance
Civil Engineering
Pomology
Physics
Wood Technology
Home Management and Housing
Chemistry
Dairy Production
Agronomy
Aeronautical Engineering
Public Speaking
Animal Husbandry

ASSOCIATE PROFESSORS

MARY BROWN ALLGOOD, M.S. (Iowa State)	<i>Home Equipment and Commercial Consumer Services</i>
CHARLES R. AMMERMAN, Ph.D. (Penn State), P.E.	<i>Electrical Engineering</i>
ELTON ATWATER, Ph.D. (American)	<i>Political Science</i>
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SAMUEL P. BAYARD, A.M. (Harvard)	<i>English Composition</i>
ANDREW A. BENSON, Ph.D. (California Tech.)	<i>Agricultural and Biological Chemistry</i>
NORRIS D. BLACKBURN, Ph.D. (Ohio State)	<i>Economic Entomology</i>
SAMUEL W. BLIZZARD, Ph.D. (Cornell)	<i>Sociology and Rural Sociology</i>
JOSEPH F. BRADLEY, Ph.D. (Pittsburgh)	<i>Finance</i>
LEO A. BRESSLER, Ph.D. (Pennsylvania)	<i>English Composition</i>
JOSEPH H. BRITTON, Ph.D. (Chicago)	<i>Child Development and Family Relationships</i>
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ROY C. BUCK, Ph.D. (Minnesota)	<i>Rural Sociology</i>
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FLOYD L. CARNAHAN, Ph.D. (Northwestern)	<i>Chemical Engineering</i>
HOWARD L. CARNAHAN, Ph.D. (Minnesota)	<i>Agronomy</i>
ELTON S. CARTER, Ph.D. (Northwestern)	<i>Speech</i>
STUART H. CHAMBERLAIN, M.S. (Michigan State)	<i>Engineering Research</i>
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TIEN-HSI CHENG, Ph.D. (Ohio State)	<i>Zoology</i>
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LEON GORLOW, Ph.D. (Columbia)	<i>Psychology</i>
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GEORGE M. GUTHRIE, Ph.D. (Minnesota)	<i>Psychology</i>
BEATRICE L. HAGEN, Ph.D. (Chicago)	<i>Mathematics</i>
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WALTER J. HARRINGTON, Ph.D. (Cornell)	<i>Mathematics</i>
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CARROLL E. HEIST, Ph.D. (Illinois)	<i>Bacteriology</i>
WILLIAM M. HENCH, Ph.D. (Pennsylvania)	<i>International Trade</i>
RODNEY E. HERSH, M.S. (Penn State)	<i>Chemical Engineering</i>
E. ELIZABETH HESTER, Ph.D. (Cornell)	<i>Foods and Nutrition</i>
ELIZABETH C. HILLIER, Ph.D. (Ohio State)	<i>Home Economics Education</i>
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THEODORE K. KARHAN, M.Ed. (Penn State)	<i>Music and Music Education</i>
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LEON R. KNEEBONE, Ph.D. (Penn State)	<i>Botany</i>
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HENRY G. LEW, Ph.D. (Brooklyn Polytech.)	<i>Aeronautical Engineering</i>
A. PAULINE LOCKLIN, M.A. (Illinois)	<i>English Literature</i>
MILDRED A. LUCEY, Ph.D. (N.Y.U.)	<i>Physical Education</i>
M. FRANK MALLETT, Ph.D. (Columbia)	<i>Agricultural and Biological Chemistry</i>
E. ORTH MALOTT, Ph.D. (Northwestern)	<i>Finance</i>
VACLAV MARES, Ph.D. (Charles University, Prague)	<i>Economics</i>
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SULLIVAN S. MARSDEN, JR., Ph.D. (Stanford)	<i>Petroleum and Natural Gas Engineering</i>
ROBERT H. MCCORMICK, M.S. (Penn State)	<i>Chemical Engineering</i>
DAVID H. MCKINLEY, M.A. (Penn State), LL.B.	<i>Banking</i>
EVERETT R. McLAUGHLIN, M.S. (Penn State), P.E.	<i>Engineering Research</i>
NEIL A. McNALL, Ph.D. (Cornell)	<i>American History</i>
MORRIS MENDELSON, Ph.D. (Cornell)	<i>Economics</i>
JOHN R. MENTZER, Ph.D. (Ohio State)	<i>Electrical Engineering</i>
WARREN W. MILLER, Ph.D. (California)	<i>Chemistry</i>
WILFORD R. MILLS, Ph.D. (Cornell)	<i>Plant Pathology</i>
JEANETTE MOLLOY, M.A. (Columbia)	<i>Elementary Education (part-time)</i>
EUGENE A. MYERS, Ph.D. (Pittsburgh)	<i>Economics</i>
VERNON W. MYERS, Ph.D. (Yale)	<i>Physics</i>
G. KENNETH NELSON, Ph.D. (Illinois), C.P.A.	<i>Accounting</i>
HAROLD E. NELSON, Ph.D. (Iowa)	<i>Speech</i>
MARGARET A. NEUBER, M.A. (Columbia)	<i>Special Education</i>
BENJAMIN W. NIEBEL, M.S. (Penn State), I.E., P.E.	<i>Industrial Engineering</i>
RALPH F. NIELSEN, Ph.D. (Nebraska)	<i>Petroleum and Natural Gas Engineering</i>

ASSOCIATE PROFESSORS

PAUL F. NORTON, Ph.D. (Princeton)	<i>Fine Arts</i>
EDWIN P. NYE, M.S. (Harvard), P.E.	<i>Mechanical Engineering</i>
GILMA M. OLSON, M.S. (Minnesota)	<i>Foods and Nutrition</i>
LESLIE M. PAPE, Ph.D. (Chicago)	<i>Philosophy</i>
LAWRENCE PARK, Ed.D. (N.Y.U.)	<i>Elementary Education</i>
JEROME K. PASTO, Ph.D. (Cornell)	<i>Farm Management</i>
ROBERT B. PATRICK, D.Ed. (Columbia)	<i>Education</i>
STUART PATTON, Ph.D. (Ohio State)	<i>Dairy Science</i>
RUTH L. PIKE, Ph.D. (Chicago)	<i>Foods and Nutrition</i>
ALBERT P. POWELL, M.S. (M.I.T.)	<i>Electrical Engineering</i>
WILLIAM E. RANZ, Ph.D. (Wisconsin)	<i>Engineering Research</i>
WILLIAM S. RAY, Ph.D. (Maryland)	<i>Psychology</i>
ROBERT R. REED, JR., Ph.D. (Columbia)	<i>English Composition</i>
ROBERT D. REIFSNEIDER, M.A. (Michigan)	<i>Dramatics</i>
J. W. CRANE REMALEY, Ph.D. (Pittsburgh)	<i>Education</i>
NEAL RIEMER, Ph.D. (Harvard)	<i>Political Science</i>
H. DAVID RIX, Ph.D. (Princeton)	<i>Physics</i>
RUSTUM ROY, Ph.D. (Penn State)	<i>Geochemistry</i>
CHRISTINE F. SALMON, M.Arch. (Pennsylvania), R.A.	<i>Housing and Home Art</i>
F. CUTHBERT SALMON, M.Arch. (Pennsylvania), R.A.	<i>Architecture</i>
ROGER B. SAYLOR, Ph.D. (Illinois)	<i>Business Statistics</i>
MARY P. SHELTON, Ed.D. (Columbia)	<i>Clothing and Textiles Research</i>
PAUL E. SHIELDS, M.S. (Pittsburgh), E.E., P.E.	<i>Electrical Engineering</i>
SAMUEL SHULITS, M.S. (Michigan College of Mining and Technology)	<i>Civil Engineering</i>
BRUCE M. SIEGENTHALER, Ph.D. (Michigan)	<i>Clinical Speech</i>
RUTH C. SILVA, Ph.D. (Michigan)	<i>Political Science</i>
F. RAYMOND SMITH, Ph.D. (Michigan)	<i>Physics</i>
WARREN S. SMITH, M.A. (Iowa)	<i>Dramatics</i>
LEO H. SOMMER, Ph.D. (Penn State)	<i>Chemistry</i>
WILLIAM SPACKMAN, JR., Ph.D. (Harvard)	<i>Paleobotany</i>
CHARLES H. STEMBER, Ph.D. (Columbia)	<i>Clothing and Textiles</i>
F. BRISCOE STEPHENS, Ph.D. (Penn State)	<i>Meteorology</i>
GLENN Z. STEVENS, Ph.D. (Minnesota)	<i>Agricultural Education</i>
RICHARD G. STONER, Ph.D. (Princeton)	<i>Physics</i>
WERNER F. STRIEDIECK, Ph.D. (Michigan)	<i>German</i>
SHIOU-CHUAN SUN, Sc.D. (M.I.T.)	<i>Mineral Preparation</i>
ROBERT W. TAFT, JR., Ph.D. (Ohio State)	<i>Chemistry</i>
DENO G. THEVAOS, D.Ed. (Columbia)	<i>Psychology</i>
GEORGE L. THURING, M.S. (Penn State), M.E., P.E.	<i>Industrial Engineering</i>
DOROTHY H. VEON, Ed.D. (Columbia)	<i>Business Education</i>
ROBERT K. VIERCK, M.S. (Iowa), P.E.	<i>Engineering Mechanics</i>
PHILIP L. WALKER, JR., Ph.D. (Penn State)	<i>Fuel Technology</i>
WALTER H. WALTERS, Ph.D. (Western Reserve)	<i>Theatre Arts</i>
GEORGE H. WATROUS, JR., Ph.D. (Penn State)	<i>Dairy Manufacturing</i>
ROBERT L. WEBER, Ph.D. (Penn State)	<i>Physics</i>
MERRILL WOOD, M.S. (Penn State)	<i>Zoology</i>
SAMUEL M. WOOLSEY, Ph.D. (Texas), C.P.A.	<i>Accounting</i>
JAMES E. WRIGHT, Ph.D. (Cornell)	<i>Genetics</i>
KELLY YEATON, M.A. (Washington)	<i>Dramatics</i>

ASSISTANT PROFESSORS

EUGENE ACKERMAN, Ph.D. (Wisconsin)	Physics
ADAM ANTHONY, Ph.D. (Chicago)	Zoology
RALPH E. ARMINGTON, M.S. (N.Y.U.), E.E., P.E.	Electrical Engineering
RALPH G. ASCAH, Ph.D. (N.Y.U.)	Chemistry
VERNON ASPATURIAN, Ph.D. (U.C.L.A.)	Political Science
RAYMOND G. D. AYOUB, Ph.D. (Illinois)	Mathematics
RICHARD P. BARTHOL, Ph.D. (California)	Psychology
JAMES B. BARTOO, Ph.D. (Iowa)	Mathematics
RONALD A. BARTOO, M.F. (Yale)	Forestry
CARL A. BAUER, Ph.D. (Harvard)	Physics
KENNETH R. BEITTEL, D.Ed. (Penn State)	Art Education
SIMON BELASCO, Ph.D. (Pennsylvania)	Romance Languages
ASA J. BERLIN, Ph.D. (Northwestern)	Speech Education
LUTHER T. BISSEY, M.S. (Penn State)	Petroleum and Natural Gas Engineering
CONVERSE H. BLANCHARD, Ph.D. (Wisconsin)	Physics
DONALD W. BLEZNICK, Ph.D. (Columbia)	Romance Languages
B. PETER BLOCK, Ph.D. (Illinois)	Chemistry
JAMES R. BLOOM, Ph.D. (Wisconsin)	Plant Pathology
GERALD BOSCH, Ph.D. (Michigan State)	Elementary Education
JOHN S. BOYLE, Ph.D. (Wisconsin)	Plant Pathology
J. NORTON BRENNAN, Ph.D. (Penn State)	Engineering Research
NICHOLAS M. BRENTIN, M.A. (Penn State)	Romance Languages
BARRY S. BRINSMAID, M.A. (Columbia)	Music
ROBERT S. BRUBAKER, Ph.D. (Illinois)	Speech
CLYDE R. BURNETT, Ph.D. (Wisconsin)	Physics
C. WAYNE BURNHAM, Ph.D. (California Tech.)	Economic Geology
WILLIAM T. BUTZ, Ph.D. (Penn State)	Agricultural Economics
GEORGE E. CEIGA, B.Mus. (American Conservatory)	Music
HUGH H. CHAPMAN, JR., Ph.D. (Harvard)	Romance Languages
MICHAEL CHIAPPETTA, Ph.D. (Michigan)	Education
RICHARD W. CLEVELAND, Ph.D. (California)	Agronomy
WILLIAM E. COBB, D.Ed. (Penn State)	Education
JOSEPH J. COMER, M.S. (Penn State)	Mineral Sciences
RALPH W. CONDEE, Ph.D. (Illinois)	English Literature
CLYDE G. CORLE, D.Ed. (Cincinnati)	Education
HOUSTON B. COUCH, Ph.D. (California)	Plant Pathology
WILLIAM CRAIG, Ph.D. (Harvard)	Mathematics
LLOYD A. CURRIE, Ph.D. (Chicago)	Chemistry
HOLLE G. DEBOER, M.A. (Colorado State College of Education)	Public Speaking
NORMAN C. DENO, Ph.D. (Ohio State)	Chemistry
FELIX DU BREUIL, Ph.D. (Penn State)	Mining Engineering
CHARLES E. DUKE, Ph.D. (Penn State), P.E.	Aeronautical Engineering
JULIAN EISENSTEIN, Ph.D. (Harvard)	Physics
ILINE FIFE, Ph.D. (Louisiana State)	Speech
KATHERINE H. FISHER, Ph.D. (Penn State)	Foods and Nutrition
JOHN A. FITZ, D.Ed. (Denver)	Education
EDWIN R. FITZGERALD, Ph.D. (Wisconsin)	Physics
LAWRENCE E. FOURAKER, Ph.D. (Colorado)	Economics
JAMES V. FRICK, Ph.D. (Iowa)	Speech
GEORGE J. FRITZ, Ph.D. (Purdue)	Botany

ROLAND H. GOOD, JR., Ph.D. (Michigan)	Physics
LIONEL GOODMAN, Ph.D. (Iowa State)	Chemistry
ROBERT J. GRACE, B.S. (Penn State), P.E.	Fuel Technology
ROBERT W. GREEN, Ph.D. (Iowa)	History
PHYLLIS R. GRIESS, Ph.D. (Penn State)	Geography
PAUL GRUN, Ph.D. (Cornell)	Genetics
CHARLES G. HAAS, JR., Ph.D. (Chicago)	Chemistry
EDGAR B. HALE, Ph.D. (Chicago)	Poultry Husbandry and Psychology Research
ROBERT I. HARKER, Ph.D. (Cambridge)	Geochemistry
L. AILEEN HOSTINSKY, Ph.D. (Illinois)	Mathematics
LING-WEN HU, Ph.D. (Penn State)	Engineering Research
GEORGE R. HUDSON, Ed.D. (Columbia)	Education
LYMAN C. HUNT, D.Ed. (Syracuse)	Education
HARRY K. HUTTON, D.Ed. (Penn State)	Secondary Education
ROBERT F. HUTTON, Ph.D. (Harvard)	Farm Management
HENRY W. JOHNSTONE, JR., Ph.D. (Harvard)	Philosophy
FRANCO P. JONA, Ph.D. (Zurich)	Physics
JOSEPH JORDAN, Ph.D. (Hebrew University, Jerusalem)	Chemistry
JOHN R. KINNEY, Ph.D. (Illinois)	Mathematics
E. ERWIN KLAUS, Ph.D. (Penn State)	Petroleum Chemistry
BORIS J. KOCHANOWSKY, Dr.Ing. (Clausthal)	Mining Engineering
ANTON J. KOVAR, Ph.D. (Rome)	Botany
DONALD T. LAIRD, Ph.D. (Penn State)	Electrical Engineering
JOSEPH T. LAW, M.A. (Wisconsin)	Political Science
ARTHUR O. LEWIS, JR., Ph.D. (Penn State)	English Literature
ERWIN E. LIEBHAFSKY, Ph.D. (Illinois)	Economics
EUGENE S. LINDSTROM, Ph.D. (Wisconsin)	Bacteriology
HAROLD L. LOVELL, Ph.D. (Penn State)	Mineral Sciences
CHARLES R. MARSH, M.S. (Illinois)	Electrical Engineering
EDWARD L. MATTIL, D.Ed. (Penn State)	Art Education
MALCOLM C. McQUARRIE, Sc.D. (M.I.T.)	Ceramic Technology
DONALD F. MITCHELL, Ph.D. (U.C.L.A.)	Genetics
J. HERBERT MOORE, M.S. (Penn State), P.E.	Civil Engineering
GERALD M. MOSER, D.U.P. (Paris)	Romance Languages
ARNULF I. MUAN, Ph.D. (Penn State)	Metallurgy
WERNER J. MUELLER, Dr.Sc.Tech. (Swiss Fed. Inst. of Tech.)	Poultry Husbandry
ROBERT K. MURRAY, Ph.D. (Ohio State)	History
WILLIAM T. NEARN, D.For. (Yale)	Wood Utilization
JOHN B. NESBITT, Sc.D. (M.I.T.)	Civil Engineering
RICHARD P. NICKELSEN, Ph.D. (Johns Hopkins)	Geology
FRANCENA L. NOLAN, Ph.D. (Penn State)	Home Management and Rural Sociology
WILLIAM J. PAGE, Ed.D. (Temple)	Education
HOWARD B. PALMER, Ph.D. (Wisconsin)	Fuel Technology
THEODORE S. POLANSKY, Ph.D. (Penn State)	Fuel Technology
THOMAS R. PORTER, Ph.D. (California)	Nature Education
WILLIAM W. PRATT, Ph.D. (Iowa State)	Physics
MARGARET C. RAABE, M.S. (Penn State)	Clinical Speech and Speech Education
ROBERT L. RIDDLE, M.S. (Iowa)	Electrical Engineering
GUY RINDONE, Ph.D. (Penn State)	Ceramic Technology
C. MARSHALL RITTER, Ph.D. (Ohio State)	Pomology
ALLAN L. RODGERS, Ph.D. (Wisconsin)	Geography
LEIF RONGVED, Ph.D. (Columbia)	Engineering Mechanics
LÉON S. ROUDIEZ, Ph.D. (Columbia)	Romance Languages

ASSISTANT PROFESSORS

CHARLES W. RUTSCHKY, Ph.D. (Cornell)	<i>Entomology</i>
DONALD P. SATCHELL, Ph.D. (North Carolina State)	<i>Soil Technology</i>
JOHN J. SCHANZ, JR., Ph.D. (Penn State)	<i>Mineral Economics</i>
MARTIN W. SCHEIN, Sc.D. (Johns Hopkins)	<i>Poultry Husbandry</i>
JOHN M. SCHEMPF, Ph.D. (Cornell)	<i>Chemistry</i>
ROBERT SCHOLTEN, Ph.D. (Michigan)	<i>Petroleum Geology</i>
JAMES W. SHIGLEY, Ph.D. (Penn State)	<i>Agricultural and Biological Chemistry</i>
SIDNEY SIEGEL, Ph.D. (Stanford)	<i>Psychology</i>
PHILIP S. SKELL, Ph.D. (Duke)	<i>Chemistry</i>
ALEX J. SLIVINSKE, Ph.D. (Virginia)	<i>Psychology</i>
CYRIL B. SMITH, Ph.D. (Penn State)	<i>Plant Nutrition</i>
C. DREW STAHL, Ph.D. (Penn State)	<i>Petroleum and Natural Gas Engineering</i>
WILLIAM A. STEELE, Ph.D. (Washington)	<i>Chemistry</i>
H. TRACY STURCKEN, Ph.D. (North Carolina)	<i>Romance Languages</i>
JACK R. TESSMAN, Ph.D. (California)	<i>Physics</i>
ROBERT Q. THOMPSON, Ph.D. (Penn State)	<i>Agricultural and Biological Chemistry</i>
GERALD M. TORKELSON, D.Ed. (Penn State)	<i>Visual Education</i>
LOREN D. TUKEY, Ph.D. (Chicago)	<i>Pomology</i>
THOMAS WARTIK, Ph.D. (Chicago)	<i>Chemistry</i>
FRANCIS L. WHALEY, Ph.D. (Michigan)	<i>Psychology</i>
THOMAS A. WIGGINS, Ph.D. (Penn State)	<i>Physics</i>
SAMUEL F. WILL, JR., Ph.D. (Yale)	<i>Classical Languages</i>
ROLF G. WINTER, D.Sc. (Carnegie Tech.)	<i>Physics</i>
ARTHUR E. WOODWARD, Ph.D. (Brooklyn Polytech.)	<i>Chemistry</i>
HAROLD D. WRIGHT, Ph.D. (Columbia)	<i>Mineralogy</i>
C. COURSON ZELIFF, Ph.D. (Cornell)	<i>Zoology</i>
LEONARD N. ZIMMERMAN, Ph.D. (Cornell)	<i>Bacteriology</i>
HARRY D. ZOOK, Ph.D. (Penn State)	<i>Chemistry</i>

INSTRUCTORS

FLORINDO V. CERRETA, Ph.D. (Columbia)	<i>Romance Languages</i>
H. TREVOR COLBOURN, Ph.D. (Johns Hopkins)	<i>History</i>
BERNARD R. JERMAN, Ph.D. (Ohio State)	<i>English Literature</i>
RICHARD N. JORGENSEN, D.For. (Yale)	<i>Wood Technology</i>
J. MITCHELL MORSE, Ph.D. (Penn State)	<i>English Composition</i>
FRANCIS J. SORAUF, Ph.D. (Wisconsin)	<i>Political Science</i>
EDWARD C. THADEN, D.U.P. (Paris)	<i>History</i>

OTHER MEMBERS OF THE GRADUATE FACULTY

EDWARD ABRAMSON, A.M. (Pennsylvania)	<i>Sociology</i>
JOSEPH ALESSANDRO, D.Ed. (Penn State)	<i>Education</i>
CHRISTINE W. AYOUB, Ph.D. (Yale)	<i>Mathematics</i>
SIDNEY A. BOWHILL, Ph.D. (Cambridge)	<i>Engineering Research (Visiting)</i>
LESLIE P. GREENHILL, B.Econ. (Melbourne)	<i>Instructional Research Program</i>
ROBERT W. HOUSE, M.S. (Ohio U.)	<i>Electrical Engineering</i>
GERHARD O. W. KREMP, Dr.Rar.Nat. (Posen)	<i>Geology</i>
N. W. McLACHLAN, D.Sc. (London)	<i>Electrical Engineering (Visiting)</i>
AMOS E. NEYHART, M.S. (Penn State)	<i>Institute of Public Safety</i>

THE GRADUATE SCHOOL

GRADUATE WORK at The Pennsylvania State University was first offered in 1862 when two graduate students were in residence. It was given more formal recognition in 1864 by the establishment of a "course for Graduates" designed for students who, after receiving the degree of Bachelor of Scientific Agriculture, wished to do advanced work leading to the degree of Master of Scientific Agriculture. For some time there were few graduate students, and graduate instruction was relatively unorganized. Later a committee of the University Senate was given the responsibility of establishing standards and regulations governing graduate work and the granting of advanced degrees. The Graduate School was organized in 1922. Until this time only master's degrees and certain technical degrees had been conferred. In 1924, upon recommendation of the Graduate School, the Board of Trustees authorized the granting of the degree of Doctor of Philosophy. Still later other degrees were approved.

The faculty of the Graduate School consists of the President and certain other general administrative officers of the University, the Deans, the University Examiner, the Librarian, the heads of departments, and those members of the instructional staff who have been authorized by the proper agencies of the Graduate School to offer graduate courses and supervise research leading to theses. It controls all academic matters pertaining to the Graduate School, subject to review by the University Senate.

The graduate faculty numbers approximately 570 members. Graduate student enrollment in 1954-55 was about 1800 per semester. During the summer sessions the graduate enrollment increased to approximately 2200. The number of advanced degrees conferred in 1954-55 was 742, of which 158 were doctor's degrees.

An applicant for admission to the Graduate School should understand that graduate work is not an extension of undergraduate work. It operates at a definitely higher level, demands scholarship of a high order, and emphasizes research and creativity. It involves a minimum of formal requirements and regulations, and a maximum of student initiative and responsibility.

A student is expected to assume full responsibility for knowing the regulations and pertinent procedures of the Graduate School (as set forth in the *Graduate School Announcement* and in the *Manual for Graduate Students*) and for meeting the standards and requirements expressed by these regulations. The *Manual*, which is available to a student after he has been admitted, sets forth in more detail the general regulations outlined in the *Announcement* and furnishes other information about the Graduate School which is useful to graduate students. Every student should secure a copy of this manual from the Dean's Office as soon after admission as possible.

PROCEDURES AND REGULATIONS

ADMISSION—A student does not become a graduate student merely by enrolling for advanced courses after having received a baccalaureate degree. Formal admission to the Graduate School is required. Credits earned before admission cannot be applied to meet degree requirements at a later date even though admission may have been granted in the meantime.

Admission to the Graduate School is granted by the Dean of Admissions after approval of the application for admission by the department in which the student

ADMISSION

plans to do his major work. Blanks to be used in making formal application for admission can be obtained from the Dean of Admissions. With his application each student should present the names of two persons to whom departments may write, and who are well qualified to evaluate his abilities for graduate work in the field of his choice.

Foreign students are encouraged to write to the Director of Foreign Student Affairs for information concerning financial matters, housing, and other nonacademic problems.

For unqualified admission to the Graduate School an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit conditions substantially equivalent to those required by The Pennsylvania State University. He must have maintained during his junior and senior years a minimum grade point average equivalent to 2.5 on The Pennsylvania State University grading scale. Finally, he must ordinarily have completed in a satisfactory manner a certain minimum of course work in designated areas, the specific courses and amount of required work depending upon the field of advanced study which the student proposes to enter. The minimum grade point average of 2.5 during the last two undergraduate years is a general requirement of the Graduate School. Individual departments may require a higher average for admission to advanced study in their fields. Prospective students are encouraged to write directly to the head of any department concerning graduate work in that specific field.

Upon recommendation of a major department, conditional admission may be granted to an applicant whose undergraduate grade point average is below 2.5 but whose qualifications in other respects seem to be such as to suggest probable success in the Graduate School. Such an applicant must realize that the initiative rests entirely with him in contacting the department of his chosen major and that, if admitted conditionally, he does graduate work at his own risk. There is no assurance that he will subsequently be granted unqualified admission or that the credits earned will automatically be applied toward degree requirements.

An applicant for admission should provide complete credentials, in duplicate, sent directly from other institutions to the Dean of Admissions at least six weeks prior to the opening of the session in which the student plans to begin his graduate program. If the applicant has attended more than one institution, two official transcripts of the work covered at each institution are required. This applies to the complete academic record, both undergraduate and graduate.

If complete credentials are not available at the time of registration, this does not necessarily mean that the application for admission will be refused. However, it does mean that the applicant will be admitted only on a provisional basis pending receipt of his official credentials. The provisional admission will be subject to cancellation if the credentials, on their arrival, do not meet all the requirements for admission to the Graduate School. Also, certification of any scheduled credits while the applicant is holding provisional admission will be withheld until receipt of his official credentials makes possible his permanent admission to the Graduate School. If the provisional admission should, for any reason, be canceled, the student is thereby automatically dropped from the Graduate School and as a consequence will be required to cease attending any 500 level courses for which he may have registered. He may continue to attend 400 level courses provided he applies for and is accepted for registration as a special student.

An applicant for admission who has done considerable high quality graduate work in a graduate school known to maintain high standards will be considered on the basis of his entire record.

Formal readmission is not required year by year nor after one or more semesters of absence from the campus unless the student has completed more than 12 credits of work at another institution in the meantime. In this case readmission is required, and evidence of good standing at the institution involved is essential. A student who has earned a master's degree at The Pennsylvania State University should not register for further degree work until his academic record and personal qualifications have been reviewed critically by the department of his major interest and a candidacy evaluation has been completed.

The President of the University, on recommendation of the Dean of the Graduate School, will welcome doctors of philosophy of The Pennsylvania State University, as well as those of other accredited colleges and universities, as guests of the University, with the privilege of attending seminars and courses and of carrying on research in laboratories and libraries. There will be no charge except for laboratory expenses. Arrangements should be made in advance with the Dean of the Graduate School.

CLASSIFICATION—At the time of admission a student is classified either as a regular graduate student or as a general graduate student. Regardless of classification, all students, upon admission to the Graduate School, must register through the Graduate Dean's office for all work taken, whether or not that work is to be credited toward the requirements for a degree.

Regular Graduate Students—This group includes those persons who plan to become candidates for degrees at The Pennsylvania State University and who have been formally admitted by the Dean of Admissions for advanced study in a particular department. The program of study is developed under the guidance of the department head or his representative. A graduate student who plans to be a candidate for an advanced degree should enroll as a regular graduate student.

It should be emphasized that a student is not a regular graduate student unless he has been officially admitted to that status. Regular attendance in the Graduate School or personal plans for future degree candidacy do not in themselves grant the status or privileges of a regular graduate student.

A regular graduate student who has passed a candidacy evaluation is classified as a doctoral candidate and may register for doctoral thesis credit.

General Graduate Students—An applicant who meets all requirements for admission to the Graduate School, but who does not wish to work for an advanced degree at this institution, may arrange for a program of work as a general graduate student. This classification includes those who plan to transfer credits to another institution and those who plan to follow a special program of study for the fulfillment of requirements other than those for advanced degrees. The program of study is developed under the guidance of an adviser appointed by the Dean of the Graduate School.

The status and standing of a general graduate student will be reviewed by the Dean each time he reregisters. He may not remain a general graduate student longer than one semester (or summer sessions totaling 12 weeks) except with the permission of the Dean, and for definite and good reasons.

When a general graduate student wishes to become a regular graduate student, i.e., to work for an advanced degree at this institution, he should make application for change of status. His undergraduate record will then be re-evaluated to determine to what extent he is prepared to undertake graduate work for a degree in the major field of his choice. He should understand that he may thereafter apply toward degree requirements only those credits earned as a general graduate student

REGISTRATION

which fit logically into an integrated degree program. There is no upper limit on the number of credits that may be so applied; neither is there any assurance that any such credits may be applicable.

Special students are not graduate students inasmuch as they have not been admitted to the Graduate School, and they are not permitted to register for graduate courses (500 series). Except for most unusual reasons, special students who are later admitted to the Graduate School may not then count toward degree requirements any credits that have been earned by them while in the special student status.

REGISTRATION—A student is required to register for each semester and each summer session in which he proposes to do either course work or research, either on or off campus, except that a candidate who has met the minimum credit requirements for his degree is required to register further only for course work, project work, and for research work which requires the use of University facilities and supplies (laboratory, library, etc.). In the case of research, the number of credits shall be determined by the amount of time required for the investigation, one credit representing one week of full-time graduate work.

For each registration the student, in consultation with his adviser, prepares a schedule of courses and research designed to fit his individual needs, which is then submitted to the Dean of the Graduate School for his approval. The registration process is then completed in the manner specified for all students at the University.

Under certain conditions credit may be earned by work done off the campus. A student contemplating such work should inquire of the Dean of the Graduate School about the procedures and conditions. Such work must be scheduled *in advance* in the regular manner.

Registration dates are given in the University Calendar and a penalty fee is assessed for failure to register on the appointed days. In any case, registration must be completed within the first two weeks of a semester or within the first one-sixth of any summer session. All changes of schedule must also be completed within this period, with the exception that a student may drop a course at any time within the first four weeks of a semester. A student who is granted permission to register after the beginning of classes will, in general, be required to take a reduced load.

ACADEMIC LOAD—A full-time student is one who devotes "all" his time to studies and/or research, and very little, if any, time to work for financial compensation. The normal maximum full-time credit load is 15 credits per semester, or 1 credit per week in shorter terms such as summer sessions. Larger loads may be scheduled very rarely and only with the approval of the Dean of the Graduate School. Ordinarily a student employed for more than a few hours per week may not register for 15 credits per semester, or 1 credit per week.

The University takes the position that the facilities of the Graduate School should be made available only to the student who can profit from his graduate school experience to a maximum extent. Therefore the Graduate School reserves the right to deny admission or registration to part-time students who (a) propose schedules of few credits which seem to reflect little real interest in graduate work or would not seem to require serious effort, or (b) wish to carry overloads of such proportions as to handicap them seriously in achieving maximum quality in their graduate work.

A part-time student who is a graduate assistant or an employee of the University is governed by the load schedules at the top of page 25.

The considerations leading to the establishment of this "protective" schedule of permitted loads for assistants and employees apply equally to part-time students employed off-campus.

EMPLOYMENT OR SERVICE LOAD		CREDIT LOAD ALLOWED	
<i>Hours per Week</i>	<i>Fraction of Full Time</i>	<i>Credits</i>	<i>Fraction of Full Load</i>
0	0	15	5/5
10	1/4	11-13	4/5
20	2/4	8-10	3/5
30	3/4	6- 8	1/2
40	4/4	6	2/5

AUDITING OF COURSES—No student is permitted to attend a class as an auditor unless he has registered officially for the course. Registration as an auditor follows the same procedure as registration for credit. Normally a student is required to count the courses audited as a part of his normal graduate load. However, a student who has demonstrated his ability to do superior work while carrying a normal graduate program (which is determined by his status as a full-time student, or as a part-time student employed on the campus or elsewhere) may, with the approval of the Dean, register for “audits” in addition to his normal credit load. To secure such approval the student should present to the Dean written evidence that the instructor of the “audit” course will accept him as an auditor, and that his adviser and the head of the department employing him (if he be employed) approve the extra load.

GRADUATION—It is the responsibility of the student to fill out a diploma card at the beginning of the semester or session at the end of which he expects to receive an advanced degree.

All degrees conferred are tentative until final grade reports have been received even though the student's name may have appeared in the printed commencement program.

Attendance at commencement exercises is an obligation on the part of those receiving advanced degrees. A request to receive the degree *in absentia* may be presented to the Dean of the Graduate School, but only under extraordinary circumstances will it be granted.

Degrees are normally granted at the end of each semester and at the end of the Main Summer Session.

ACADEMIC DEGREES

MASTER OF ARTS AND MASTER OF SCIENCE

These two degrees have similar requirements, the particular degree conferred upon the student being determined by the general area in which his major field is situated.

ADMISSION—Adequate undergraduate preparation is required in the field in which the applicant expects to pursue advanced work. The specific courses and the total number of undergraduate credits required in various areas will be determined by the choice of field and can be ascertained from the Dean of Admissions. An applicant who meets the minimum grade point average but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A program for the master's degree requires a minimum of 30 credits and consists of a major and either a minor or a group of general studies. A minor consists of not less than 6 credits of integrated or articulated work in one field related to but different from that of the major. A general studies group consists of no fewer than 6 credits in fields other than that designated as the major field considered by the major department to have significance and value for the candidate.

The program requires the equivalent of at least one academic year (two semesters), and may be met by full-time residence, part-time work, attendance in the summer sessions, or by any combination of these. Many students find that adequate programs leading to the master's degree involve considerably more than 30 credits and require more than one year's work. Ten credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State University may, under certain conditions, be offered in partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A minimum of 12 credits in course work, as contrasted with research, must be completed in the major field and at least 6 credits in addition must be devoted to a thesis. At least 18 credits in graduate courses (500 series) and thesis research combined must be offered toward the fulfillment of minimum requirements for the degree. A student's program must be approved by his adviser and the Dean.

In addition to the above general requirements, major departments may set up specific course and subject-matter requirements for students working in their area.

The mere completion of a stated amount of work does not entitle a student to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS—Under the direction of the department in which the student's major subject is taken, he must prepare a thesis upon a suitable topic related to that subject. Under certain conditions a student may be permitted to complete the thesis *in absentia*. To obtain such permission he must make satisfactory arrangements in advance with both the major department and the Dean.

A copy of detailed regulations concerning format, paper, illustrations, etc. may be obtained at the Graduate School office.

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced by (1) the satisfactory completion of a prescribed period of study and investigation, (2) the preparation of a thesis involving independent research, and (3) successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State University in regular semesters. During at least two semesters, if he be a part-time student, the candidate is expected to limit his work load to half-time at most and to devote the balance of his time to his graduate program. A minimum of three academic years of full-time graduate study and research, or their equivalent, is required for the attainment of a doctor's degree. The equivalent of two academic years may be secured by residence at another institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and thesis requirements within the period of one academic year on this campus.

Subject to the approval of his adviser, the head of his major department, and the Dean of the Graduate School, a student may register for research to be done off-campus. Such work will not be approved, however, simply because the arrangement is convenient for the student; scholarly considerations must determine the choice of location.

A student devoting only a portion of his time to his program will be credited on his residence requirements in proportion to the time actually spent in graduate study and research.

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The program shall consist of such a combination of courses and research as is approved by the doctoral committee for each individual student, and includes a major and either a minor or a group of general studies. Approximately two-thirds of the total time is to be devoted to the major field. A minor consists of no fewer than 15 credits, including those applied toward the master's degree, of integrated or articulated work in one field related to but different from that of the major. A general studies group consists of no fewer than 15 credits, including those applied toward the master's degree, in fields other than that designated as the major field considered by the major department to have significance and value for the candidate.

The first year of graduate study leading to the doctor's degree may be substantially the same as that provided for the master's degree and may lead to that degree, although that is not necessary.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Philosophy must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of graduate work (including work done for the master's degree and work done elsewhere as well as here). A student transferring from another graduate school must

take this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department. If the student passes the examination, and in the opinion of the graduate faculty of his major department is qualified to follow a doctoral program, he is admitted to candidacy.

After a student has been admitted to candidacy the Dean will appoint, upon recommendation of the head of the major department, his doctoral committee which will thereafter guide him in candidacy.

For the Doctor of Philosophy degree, candidates are required to have a reading knowledge of at least two foreign languages. German and French are the languages most often needed. Other languages may be presented instead of these if their choice is determined by scholarly and professional reasons. The choice of a language must be approved by the major department. If a language other than English, French, German, Italian, Spanish, or Russian is presented, it must be approved also by the Dean of the Graduate School. A student may not present his mother tongue as one of the two languages required in candidacy. Candidates may present certification of having passed equivalent language examinations in other institutions in lieu of repeating the examinations. For further details, see the *Manual for Graduate Students*.

When a doctoral candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether he has adequate mastery of the subject matter to entitle him to proceed to the completion of a thesis. The candidate must have satisfied the language requirements before taking this examination.

A doctoral candidate who has satisfied all other requirements for the degree will be scheduled, on recommendation of the doctoral committee, to take a final examination. In no case may the final examination be scheduled less than three months after the comprehensive examination. The final examination is oral, open to the public, related in large part to the thesis, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

THESIS—The ability to do independent research must be proved by the preparation of a thesis on some topic related to the major subject. It should represent a significant contribution to knowledge, be presented in a scholarly manner, reveal on the part of the candidate an ability to do independent research of high quality, and indicate considerable experience in using a variety of research techniques. The contents and conclusions of the thesis must be defended at the time of the final examination.

The general subject of the thesis must be determined at the time of admission to candidacy for the degree, and the completed thesis, typewritten in triplicate, must be filed in the office of the Dean of the Graduate School not later than two weeks prior to the commencement at which the candidate expects to receive the degree.

A copy of detailed regulations concerning format, paper, illustrations, etc. may be obtained at the Graduate School office.

PROFESSIONAL DEGREES

MASTER OF EDUCATION

In order to provide programs of advanced work which would utilize more fully the professional training and background of those holding bachelor's degrees from teachers colleges and schools of education, two professional degrees in education were established.

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership in educational work, and ability to solve concrete problems in at least one special field of educational activity.

ADMISSION—An applicant is required to have had at least 27 undergraduate credits in the field of education, including practice teaching, except that under certain circumstances this rule may be waived for a student working for the Doctor of Education degree with a major in higher education. An applicant choosing a major outside the fields of education (such as mathematics, geography, or history) will be expected to have in addition an adequate undergraduate preparation in the field of specialization. The specific course requirements and the total number of undergraduate credits required in the various areas will be determined by the choice of field and can be ascertained from the Dean of Admissions. An applicant who meets the minimum grade point average for admission but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A minimum of 30 credits is required, of which 6 may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters) and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Ten credits earned in residence at another approved institution or in extension classes of The Pennsylvania State University may, under certain conditions, be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A minimum of 24 credits must be earned in graduate course work. The larger part of this work shall be in courses open only to graduate students, but the needs of the student shall be considered in arranging the best combination of courses (400 and 500 series) for the preparation of the candidate in his special field. The degree program must be approved by the student's adviser or advisory committee.

When the student chooses a group major, his study program will be approved by a standing committee (or its representatives), which committee will foster the student's interests and stand in the same relation to him as does a department in the case of a student with a specific major. Such standing committees have been appointed in the broad fields of biological science, physical science, and social studies.

If a thesis is included in the program, it must be done under the direction of a supervisor representing either a major department or a standing committee supervising group majors. An amount of time equivalent to six credits may be devoted to research and the preparation of the thesis. Under certain conditions this may be carried out in part *in absentia*, particularly when requirements are met by summer session attendance.

DOCTOR OF EDUCATION

Those candidates who do not elect to write a thesis are required to present an essay or term paper. It must be of considerable proportion, giving evidence of their capacity to describe a serious intellectual experience in writing, and giving unmistakable evidence of ability to formulate and state meaningfully the purpose of an investigation, study, critical analysis or evaluation, to acquire and analyze information, to draw conclusions logically, and to relate findings to professional problems and practices. The particular nature and extent of such a piece of writing (whether it be required in connection with a course or independently of course work), and when it is to be undertaken, shall be determined by the major department.

MAJOR AND MINOR FIELDS—If a student looks forward to a career as a teacher, he may choose a major outside the fields of education (such as English, mathematics, or geography) and take the majority of his work in that field. In this case the student is required to have a minor consisting of no fewer than 6 credits in basic education (includes comparative education, educational measurements and statistics, educational psychology, history of education, and philosophy of education). If he can demonstrate by examination an adequate background in basic education, he may choose a minor in any field of education.

If a student wishes to work in a broader field, a group major such as social studies, physical science, or biological science may be chosen. In this case at least 24 credits are to be devoted to the group, and no fewer than 6 credits to a minor in basic education. It is expected that each student will choose one subject of the group as a field of primary interest, to which at least 12 credits are to be devoted.

If a student looks forward to a career as an administrator, a guidance counselor, or a supervisor, he may specialize in one of the fields of education and choose that as his major. In this case the student is required to have a minor consisting of no fewer than 6 credits in either a field outside of education or in basic education as defined above.

EXAMINATIONS—A candidate for the Master of Education degree must pass a final comprehensive examination. The examination will be designed to determine the ability of the candidate to apply the general as well as the special knowledge of his chosen field in practical situations.

A candidate majoring in education is required to take a departmental qualifying examination, comprehensive in scope, before completing the second half of his course requirements. This serves as a guide in outlining a program of study that will fit his individual needs.

DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced (1) by the satisfactory completion of a prescribed period of study; (2) by the application of scientific principles in classroom teaching, in the supervision of instruction, or in administrative work; (3) by the preparation of a thesis demonstrating ability to undertake an educational problem with originality and independent thought; (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects; and (5) by recognized leadership in the profession of education.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State University. This requirement may be met by attendance at summer sessions, although there is no guarantee that it will be pos-

sible to do so in all cases. An equivalent of three years of graduate study is required as a minimum for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

The equivalent of two full years of work may be secured by residence at another institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and thesis requirements within the period of one academic year on this campus. Credit for courses and research work done elsewhere can be used to meet degree requirements only if appropriate to the candidate's proposed program of study as determined by his doctoral committee.

One third of the requirements (equivalent to a 30-credit year) for the degree may be met by research work pursued away from the campus in the school systems of the State, or in other approved centers, provided (1) the plan be approved by the candidate's doctoral committee, (2) reports on the projects be made as directed by this committee, (3) not more than 6 credits be earned in a semester, and (4) the arrangement be approved by the Dean.

Work done off the campus which is to be credited toward a doctor's degree must be scheduled *in advance*, following regular registration procedure.

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a period of residence, a satisfactory thesis, the passing of comprehensive examinations, and possession of the qualities of professional leadership. A program shall consist of such a combination of courses and individual study and research as is approved by the doctoral committee for each candidate. The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement must be in the major field of study.

A candidate choosing a major outside the fields of education (such as chemistry, English, or history) shall have a minor consisting of no fewer than 15 credits, including those applied toward the master's degree, in psychology and basic education (includes comparative education, educational measurements and statistics, educational psychology, history of education, and philosophy of education).

A candidate choosing a major in one of the fields of education must also choose either a minor or a group of general studies with the approval of the major department. In this case a minor consists of no fewer than 15 credits, including those applied toward the master's degree, in one field outside the fields of education. An acceptable general studies group consists of no fewer than 15 credits, including those applied toward the master's degree, in fields outside the fields of education considered by the major department to have significance and value for the candidate. Every candidate must show through comprehensive examinations that he is familiar with current theories of education, that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject, that he is prepared to read understandingly and contribute to the technical and professional literature in his field, and that he can criticize his own procedures in the light of historical trends and practices in this and other countries. Command of the tools for a thorough study of the problems of education is necessary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

MASTER OF FORESTRY

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Education must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of graduate work (including work done for the master's degree and work done elsewhere as well as here). A student transferring from another graduate school must take this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department.

Three of the important factors taken into consideration in passing judgment upon admission to candidacy are:

1. Previous scholastic record at this institution and other institutions attended.
2. Achievement in qualifying examinations.
3. Estimates of the student's personal and professional qualifications by the graduate faculty of the major department.

After a student has been admitted to candidacy, the Dean, upon recommendation of the head of the major department, will appoint his doctoral committee which will thereafter guide him in candidacy.

When the candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether or not he is to be permitted to proceed to the completion of his thesis. This examination will be designed to test (1) the candidate's general scholastic preparation and professional background, and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

A candidate who has fulfilled all other requirements for the degree will, on recommendation of his doctoral committee, be permitted to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's doctoral committee and others appointed by the Dean of the Graduate School. In no case may the final examination be scheduled less than three months after the comprehensive examination. The final examination will be based largely upon the thesis, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

THESIS—Evidence of a high degree of scholarship and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written thesis. The candidate must demonstrate capacity for independent thought as well as ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed thesis must have the approval of the doctoral committee.

A copy of detailed regulations concerning format, paper, illustrations, etc. may be obtained at the Graduate School office.

MASTER OF FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for

MASTER OF PUBLIC ADMINISTRATION

additional study in a student's particular field of interest rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

ADMISSION—An applicant for admission is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission, they must be removed early in the program. While making up deficiencies in prerequisite credits, the student must follow a program approved by his advisory committee. Deficiencies in grade point average will lead to refusal of admission to the Graduate School.

REQUIREMENTS—A minimum of 30 credits is required for the degree of Master of Forestry. It is expected that the larger part of the program shall be in graduate courses, but no specific number of credits in the 500 series is required. A thesis representing a minimum of 6 credits must be prepared. Under certain conditions a student may be permitted to complete the thesis *in absentia*. To obtain such permission he must make satisfactory arrangements in advance both with the head of the department and with the Dean. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A maximum of 10 credits earned in extension classes of The Pennsylvania State University or in resident classes of other approved institutions may, under certain conditions, be applied toward the degree provided they fit into the program of the student.

A student should choose one field of work for his major interest, with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with the student's advisory committee.

MASTER OF PUBLIC ADMINISTRATION

The program leading to the degree of Master of Public Administration is designed to provide pre-service training for students planning to enter the field of public administration at the national, state, or local level. It is a terminal program and cannot be applied toward a doctorate.

ADMISSION—An applicant must be admitted to the Graduate School and be approved by a departmental committee before entering upon the program. A class of limited size will be selected on the basis of scholastic records, occupational interest, and general qualifications. An all-University average of at least B is required. Selection will be largely from majors in Liberal Arts, Business Administration, and Engineering.

REQUIREMENTS—The program covers a 12-month period and consists of two semesters of work on campus, followed by an internship of 6 weeks in some governmental agency. The course of study is made up of subject blocks, such as organization, management, personnel administration, budgeting, finance, accounting, public works administration, administrative law, planning, statistics, report writing, speech, and public relations. The student has a major in public administration and a minor in either public finance or public works depending upon his interest.

TECHNICAL DEGREES

In lieu of a thesis, the student is required to submit an extensive written report on a project which has been carried out during his internship.

The Institute of Local Government serves as the agent of the Department of Political Science for the purpose of administering the program.

TECHNICAL DEGREES

The degrees conferred are Fuels Engineer, Ceramic Engineer, Engineer of Mines, Metallurgical Engineer, and Petroleum Engineer.

ADMISSION—A graduate of the College of Mineral Industries of The Pennsylvania State University may be admitted to work for a technical degree, provided he submits evidence of having been engaged for a period of not less than three years in acceptable professional work in the field in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in engineering in a professorial rank in this institution, and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees.

An applicant for a technical degree must file with the Dean of Admissions an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the admission fee of \$5.

REQUIREMENTS—Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his application for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate College concerned.

Registration for these degrees is the same as for resident students. A candidate must be registered during two regular semesters.

In order to be recommended for a technical degree, the candidate must prepare a thesis on a subject related to his profession, and he may be required to appear in person to defend his thesis.

THESIS—Immediately following registration the candidate must submit for approval an outline of his proposed thesis; and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

GENERAL INFORMATION

FEES—

REGULAR FEES, PAID EACH SEMESTER:

Students registered for 12 or more credits:

Residents of Pennsylvania	\$120.00
Nonresidents of Pennsylvania, on-campus studies	245.00
Nonresidents of Pennsylvania, off-campus research (610)	120.00

Students registered for fewer than 12 credits:

Residents of Pennsylvania, per credit	11.00
Nonresidents of Pennsylvania, on-campus studies, per credit	21.00
Nonresidents of Pennsylvania, off-campus research (610), per credit	11.00

Vocational education courses:

Total charge for vocational education courses, indicated by "v" following the course number	15.00
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Graduate assistants, fellows, and scholars:

Health and welfare charge	18.00
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SPECIAL FEES, PAID AS OCCASION DEMANDS:

Applicable to all students, including graduate assistants, fellows, and scholars:

Admission to the Graduate School	5.00
Privilege of late registration or late payment	10.00
Change of schedule, each change	2.00
Publication of doctoral thesis abstract	35.00
Official transcript of record (with seal), each copy	1.00

The University reserves the right to revise fees without further notice.

With reference to fees, courses that are scheduled for audit are considered the same as though they were scheduled for credit.

Summer sessions students who register for graduate courses pay the regular fees for the summer sessions.

Whenever it shall appear from any of the data presented as part of the application for admission that the applicant is not domiciled in Pennsylvania, the Dean of Admissions, when admission is granted to that applicant, assumes that he is a non-Pennsylvanian and includes that admission as part of the established out-of-State quota.

If an entrant, classed as out-of-State, believes that his circumstances do not justify his classification as a non-Pennsylvanian, he may petition the Dean of Admissions for reclassification.

Whenever such a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous domicile of the one admitted (or of his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding his admission, and, in addition, such other evidence as may appear pertinent to a complete review of his classification.

Any student who does not fulfill payment obligations promptly may be charged \$1 for each day of delinquency up to and including five days, or a maximum of \$10 if the delinquency exceeds five days. A student whose account is delinquent for more than 10 days is subject to suspension from the University.

LIVING ACCOMMODATIONS

LIVING ACCOMMODATIONS—A variety of living accommodations are available including rooms in private homes, lodging houses, and to a limited extent in University residence halls. Boarding houses and restaurants are available for meals. The cost varies considerably but has been estimated at approximately \$21 per week, including both board and room. The office of the Dean of Men and the office of the Dean of Women attempt to maintain a list of known vacancies. The prospective student should write to the appropriate office well in advance of the beginning of school because it may be very difficult to find a convenient location at the last minute.

A married student may find accommodations in apartments, trailers, and rooms in private homes. Personal contact is essential, but assistance may be gained through contact with the office of the Dean of Men or an advertisement in the local newspaper.

A limited number of married students may be admitted to Eastview Terrace, a housing development consisting of small one- and two-bedroom unfurnished units located on the campus. Applications are considered in the order in which they are received. For details write to the Director of Housing, Old Main.

GRADING SYSTEM—A grade is given to a student solely on the basis of the instructor's judgment as to his scholarly attainment.

For graduate courses (500 series) one of three grades may be given:

H for Honors, indicating definitely superior attainment.

P for Pass, indicating acceptable but not superior attainment.

F for Fail, indicating failure to attain the minimum standards of work acceptable for credit in a degree program.

For research or thesis one of four grades may be given:

H for Honors, indicating definitely superior attainment.

P for Pass, indicating acceptable but not superior attainment.

F for Fail, indicating failure to spend an appreciable amount of time doing the scheduled work or failure to attain the minimum standards of work acceptable for credit in a degree program.

R for Research, indicating that the investigation is continuing and that the student has devoted an adequate amount of time to the work scheduled but that the supervisor does not want to give a quality grade (H, P, or F) at this point. When the project is completed an H, P, or F must be given and will be considered the quality grade for the entire research. Grades of R given while the research was in progress will remain on the student's record permanently.

For 400 series courses one of five grades may be given:

<i>Grade</i>	<i>Percentage Equivalent</i>	<i>Grade Point Equivalent</i>
A	90-100	4
B	80- 89	3
C	70- 79	2
D	60- 69	1
F (Failure)	0- 59	0

Grades below B do not carry graduate credit.

HEALTH SERVICE—The University Health Service is available to any graduate student who registers for 12 or more credits or who holds an appointment as a fellow, a graduate assistant, or a scholar. This service endeavors to conserve, maintain,

and promote the health of students. Consult the *Manual for Graduate Students* for details concerning its facilities and services.

PLACEMENT SERVICE—The University Placement Service is designed to co-ordinate the placement activities of all the Colleges and the Graduate School. The services of the following divisions are available to the student without charge.

The Placement Service functions primarily as a clearing house, bringing together students, alumni, faculty members, and representatives of organizations that are seeking college-trained personnel. Summer jobs other than those at camps or resorts are listed at this office.

The Teacher Placement Division is maintained to assist seniors, alumni, and graduate students in all departments in securing teaching positions for which they are qualified.

The Student Employment Division offers assistance to students in finding part-time employment in town and on the campus, as well as summer employment at camps and resorts. A student must be registered to be informed of jobs.

The divisions of the University Placement Service are available to any student, regardless of level, who is in need of counseling or guidance on employment problems.

RELIGIOUS ORGANIZATIONS—The University seeks to serve the spiritual needs of its students and staff. General responsibility for religious activity on the campus rests with the University Chaplain and Co-ordinator of Religious Affairs. Individual organizations under the sponsorship of members of the Jewish, Protestant, and Roman Catholic faiths serve the student body. Many other religious organizations, including denominational and interdenominational groups, are active on the campus and in association with local churches.

SELECTIVE SERVICE—The University attempts to keep local draft boards fully informed in regard to the status and progress of all students who are subject to Selective Service regulations. Responsibility for this matter is placed in the Office of the Assistant Registrar, and all communications between University staff members and local boards are cleared through this office. As soon as an applicant has been admitted to the Graduate School, his local board will be so informed provided the applicant has given the necessary information.

SENIOR STUDENT PRIVILEGES—A senior student of The Pennsylvania State University lacking not more than 4 credits for graduation may be admitted to the Graduate School. This limit of 4 credits may be increased to 8 in the case of a student with an average of at least B (a grade point average of 3). Other senior students, while not admitted to the Graduate School, may, if their records are superior, be admitted to graduate courses (500 series) upon the approval of the instructor of the course to which the student desires admission, and of the Dean of the Graduate School.

SUMMER SESSIONS—A series of sessions covering a total period of 12 weeks are arranged each summer. During this time there are excellent opportunities for graduate work in many fields. Detailed information can be secured from the *Summer Sessions Complete Announcement*, which is published about April 1 and may be obtained by writing to the Director of Summer Sessions.

It is the aim of the University to make available its staff and resources during the summer to aid students to the fullest possible extent in their programs of graduate study and research. The University cannot guarantee, however, that all the services normally offered during the academic year will be at hand during the summer.

ASSISTANTSHIPS

To avoid disappointments, a student who plans to present a thesis for final consideration or to take the final doctoral examination during the summer sessions should inform the chairman of his committee and the head of his department of his intentions prior to June 1. A notice of approval will be sent to the student if the necessary staff members will be available to provide the service requested.

A graduate student desiring to carry forward a special graduate program or research project not officially listed as a part of the Summer Sessions should, likewise, obtain written approval of his plans from the chairman of his committee and the head of his department prior to June 1.

ASSISTANTSHIPS, FELLOWSHIPS, AND OTHER AIDS

ASSISTANTSHIPS—A number of graduate assistantships are available to students who show promise of superior ability to carry on graduate study. An appointee may serve as an assistant in classroom or laboratory instruction, or in research or office work. His appointment may be for the academic year or for the fiscal year. Exemption from all major fees and charges is granted, but the student must pay the health and welfare charge as well as such specific fees as admission, late registration, and change of schedule. Privileges for a graduate assistant appointed for the academic year do not extend into any of the summer sessions. A veteran holding an assistantship is not in general eligible for full benefits from the Veterans Administration.

An appointee may not accept additional employment, either at the University or elsewhere, during the period for which service to the University is required under the appointment. A graduate assistant appointed for the fiscal year is permitted an allowance for time off with pay, including vacation and sick leaves, equivalent to 30 calendar days per year, the vacation to be scheduled at the convenience of the department. Vacation for a graduate assistant on appointment for the academic year consists of the regular student vacations available to graduate students, or an equivalent amount of time off during the academic year at the convenience of the department.

A student holding a quarter-time or a half-time assistantship is considered to be following a full-time course of instruction under Selective Service regulations and is certified to his local draft board as a full-time student.

Prospective students should write directly to the head of their major department for information and application forms. Appointments are made upon the recommendation of the department head, subject to admission to the Graduate School and to the approval of the Dean of the Graduate School. Clear evidence of superior ability and promise is required. Reappointment to an assistantship requires a continuing demonstration of good scholarship.

The three types of graduate assistantships vary in stipend, service required, and the number of credits for which the student may register. Not all types will be available in every department.

QUARTER-TIME, requiring about 10 hours of service per week.

For the academic year: stipend \$590; 11-13 credits per semester.

For the fiscal year: stipend \$780; 11-13 credits per semester, 8-10 credits in summer sessions.

HALF-TIME, requiring about 20 hours of service per week.

For the academic year: stipend \$1180; 8-10 credits per semester.

For the fiscal year: stipend \$1572; 8-10 credits per semester, 6-8 credits in summer sessions.

THREE-QUARTER TIME, requiring about 30 hours of service per week.

For the academic year: stipend \$1770; 6-8 credits per semester.

For the fiscal year: stipend \$2352; 6-8 credits per semester, 5-6 credits in summer sessions.

COUNSELORSHIPS—The Dean of Men has available a number of appointments as resident counselors in the men's residence halls. Their responsibility is to work for the social, academic, and emotional adjustment of the undergraduate residents. Specialized training in personnel work is desirable, though not essential.

These appointments are for the academic year and carry with them remission of fees for room and board, but not exemption from academic fees.

Applications should be addressed to the Dean of Men.

FELLOWSHIPS—Approximately 80 fellowships are available to enable superior graduate students to devote all their time to study and research. Fellows render no service, though in some cases they will be expected to conduct their research within broad fields specified by the donors. They will be expected to register for full-time graduate programs and not to accept additional employment. Fellowships yield stipends in varying amounts and carry with them exemption from the major fees, but not from the health and welfare charge and other specific fees such as admission, late registration, and change of schedule.

Requests for additional information and application forms should be addressed to the head of the major department concerned.

The fellowships which are available will vary somewhat from year to year, but the following are typical of those which were awarded for 1955-56:

ALLEGHENY LUDLUM FELLOWSHIP—Open to graduate students in metallurgy for studies in steelmaking.

ALLIED CHEMICAL AND DYE FELLOWSHIP—Open to graduate students in chemical engineering.

ALLIED CHEMICAL AND DYE FELLOWSHIP—Open to graduate students in organic chemistry for the final year of study leading to the Ph.D. degree.

AMERICAN PETROLEUM INSTITUTE FELLOWSHIPS (8)—Open to graduate students in chemistry and physics for research concerning the synthesis and properties of high molecular weight hydrocarbons.

ANTHRACITE FELLOWSHIP—Open to graduate students in fuel technology for studies on anthracite.

CALIFORNIA COMPANY FELLOWSHIP—Open to graduate students in geology and mineralogy for studies in sedimentary petrology or stratigraphy.

CARNEGIE GRADUATE FELLOWSHIPS (3)—Open to advanced level graduate students.

CONTINENTAL OIL COMPANY FELLOWSHIP—Available to graduate students in petroleum and natural gas engineering for studies in petroleum engineering.

CO-OPERATIVE GRANGE LEAGUE FEDERATION FELLOWSHIP—For the support of research in poultry nutrition, with major interest in biochemistry.

CO-OPERATIVE PROGRAM FELLOWSHIP—Open to graduate students in metallurgy.

FELLOWSHIPS

CURTISS-WRIGHT CORPORATION FELLOWSHIP—Open to graduate students in aeronautical engineering, electrical engineering, mechanical engineering, and engineering mechanics.

DANFORTH FOUNDATION FELLOWSHIPS—For graduate students in the natural sciences, social sciences, humanities, and other fields of specialization preparing themselves for college teaching, who see in teaching a vocation of Christian service.

DOW CORNING FELLOWSHIPS—Open to graduate students in chemistry for fundamental studies in organosilicon compounds.

DU PONT POSTGRADUATE TEACHING FELLOWSHIP IN CHEMISTRY—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

DU PONT FELLOWSHIP IN MECHANICAL ENGINEERING—Open to graduate students in mechanical engineering, preferably those working toward the Ph.D. degree.

EDWARD ORTON, JR., CERAMIC FOUNDATION FELLOWSHIP—Open to graduate students in ceramics for studies relating to kiln-fired ceramic bodies.

ELLIOTT FELLOWSHIP IN ENGINEERING RESEARCH—An annuity provided by W. S. Elliott of Pittsburgh for a student in engineering who must be a graduate.

FOUNDRY EDUCATIONAL FOUNDATION FELLOWSHIP—Open to graduate students in mechanical engineering, industrial engineering, and metallurgy who have demonstrated interest in foundry technology.

GENERAL ELECTRIC FELLOWSHIP—Open to graduate students in metallurgy.

GULF COMPANY FELLOWSHIP IN MINERALOGY—Open to graduate students in mineralogy for studies in sedimentation.

GULF COMPANY FELLOWSHIP IN MINING—Open to graduate students in mining engineering for studies in underground rock structures.

GULF COMPANY FELLOWSHIP IN PHYSICS—In support of graduate work in the field of X-ray crystallography.

HAMILTON STANDARD FELLOWSHIPS (3)—Open to graduates of this University in aeronautical engineering, electrical engineering, and mechanical engineering.

KENNECOTT COPPER CORPORATION FELLOWSHIP IN GEOPHYSICS—Open to graduate students in geophysics for studies relating to mining geophysics.

PENNSYLVANIA BANKERS ASSOCIATION FELLOWSHIP—Open to graduate students in business administration and economics for studies in money, banking, and finance.

PENNSYLVANIA CO-OPERATIVE POTATO GROWERS ASSOCIATION FELLOWSHIP—In support of research concerning soil and fertility factors affecting yields and quality of potatoes.

PENNSYLVANIA CO-OPERATIVE WILDLIFE RESEARCH FELLOWSHIPS (3)—Funds supplied by the Pennsylvania Game Commission for investigations dealing with wildlife management.

PITTSBURGH CONSOLIDATION COAL COMPANY FELLOWSHIP—Open to graduate students in fuel technology for research leading to the Ph.D. degree.

ST. JOSEPH LEAD COMPANY FELLOWSHIP—Open to graduate students in metallurgy for studies in chemical metallurgy.

SHELL COMPANY FELLOWSHIP IN CHEMICAL ENGINEERING—In support of graduate work in chemical engineering, preferably for students in their last year of doctoral work.

SHELL COMPANY FELLOWSHIP IN CHEMISTRY—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

SINCLAIR FELLOWSHIP IN PETROLEUM PRODUCTION—Available to graduate students in petroleum and natural gas engineering for studies in petroleum production.

SPEER FELLOWSHIP—Open to graduate students in fuel technology for studies on carbon.

STACKPOLE FELLOWSHIP—Open to graduate students in fuel technology for studies on carbon.

STACKPOLE FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy for studies in powder metallurgy.

STANOLIND FELLOWSHIP IN PETROLEUM AND NATURAL GAS ENGINEERING—Available to graduate students in petroleum and natural gas engineering for studies in petroleum production.

TITAN METAL FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy for studies on copper-base alloys.

UNION CARBIDE AND CARBON FELLOWSHIP—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

UNION CARBIDE AND CARBON FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy.

UNITED STATES STEEL FOUNDATION FELLOWSHIP—Open to graduate students in the College of Mineral Industries for studies related to steelmaking.

WEIRTON FELLOWSHIP—Open to graduate students in metallurgy for studies in steelmaking.

JOHN W. WHITE FELLOWSHIPS—Awarded to two graduates of The Pennsylvania State University each year on the basis of scholarship, need, character, and attitude. The recipients may enroll in any approved college or university.

In addition, numerous grants are available from governmental agencies, industrial concerns, and foundations for the support of investigations of particular problems. Many of these permit full-time study and carry the same fee exemptions as the fellowships listed above. Detailed information can be secured from departments.

LOAN FUNDS—Loan funds are available to a limited extent. Applications should be addressed to the Dean of Men or the Dean of Women.

SCHOLARSHIPS—A number of scholarships are awarded annually. Applications should be addressed to the Dean of the Graduate School and must be received by March 1 in order to be considered for the following academic year.

GRADUATE SCHOLARSHIPS—Forty are awarded each year. These scholarships carry no stipend but do grant exemption from all major fees. Recipients are required to take a full program of graduate work and may be required to render some service.

A.A.U.W. SCHOLARSHIP—The State College Branch of the American Association of University Women has established a scholarship for a woman graduate student. The amount of the award varies and does not include fee exemption.

STUDENT EMPLOYMENT—Many students depend partly on their own earnings to help meet their expenses. The Student Employment Office, 112 Old Main, gives information on part-time jobs. A student not holding an assistantship, fellowship, or scholarship who wants a part-time job should register with the Student Employment Office as soon as his class schedule has been arranged. While some students find regular part-time work, many of them depend on a series of odd jobs, some of which are of a continuing nature.

VETERANS BENEFITS

VETERANS BENEFITS—The Co-ordinator of Veterans Affairs is charged with the responsibility of handling all applications for benefits under the various Public Laws.

Under P.L. 550 the responsibility for classifying students as to their rate of training rests with the Dean of the Graduate School. The classification is based on the extent to which the student devotes himself to his graduate program (as contrasted with the service for which he receives remuneration) and is not directly determined by the number of credits scheduled. Thus a student who is employed about 20 hours per week and devotes the remainder of his time to graduate work would be considered a half-time student on the basis of his employment regardless of how many credits he was permitted to schedule.

FIELDS OF STUDY

Majors Minors

Graduate Courses

FIELDS IN WHICH BOTH MASTER'S AND DOCTOR'S DEGREES ARE OFFERED

Aeronautical Engineering	Geophysics
Agricultural and Biological Chemistry	German
Agricultural Economics	Guidance
Agricultural Education	* Higher Education
Agronomy	History
Animal Husbandry	Home Economics Education
Animal Nutrition	Home Management and Family Economics
Art Education	Horticulture
Bacteriology	Industrial Arts Education
Botany	Industrial Engineering
Business Administration	Mathematics
Business Education	Mechanical Engineering
Ceramic Technology	Metallurgy
Chemical Engineering	Meteorology
Chemistry	Mineral Economics
Child Development	Mineral Preparation
Civil Engineering	Mineralogy
Clinical Speech	Mining
Clothing and Textiles	Music Education
Comparative Literature	Nutrition
Dairy Science	Petroleum and Natural Gas Engineering
Economics	Physical Education
Educational Administration	Physics
Electrical Engineering	Political Science
Elementary Education	Poultry Husbandry
Engineering Mechanics	Psychology
English	Recreation Education
Family Relationships	Romance Languages
Fuel Technology	Rural Sociology
General Home Economics	Secondary Education
Geochemistry	Sociology
Geography	Speech
Geology	Vocational Industrial Education

FIELDS IN WHICH ONLY A MASTER'S DEGREE IS OFFERED

Agricultural Engineering	Health Education
Architectural Engineering	Institutional Administration
Architecture	Journalism
Biological Science	Music
Child Development and Family Relationships	Nutrition in Public Health
Dramatics	Philosophy
Entomology	Physical Science
Fine Arts	Public Administration
Foods	Sanitary Engineering
Forestry	Social Studies
	Wildlife Management
	Zoology

* The doctor's degree is conferred in this field but not the master's degree.

FIELDS OF ADVANCED STUDY

PROGRAMS OF STUDY leading to advanced degrees are offered in many major and minor fields. These are listed in alphabetical order on the following pages. Related courses are grouped together under the name of the field. To locate a particular field or group of courses consult the index in the back of this bulletin.

In general, departments of the University are identified with specific major fields of study. Thus Aeronautical Engineering is a major field which is offered under the supervision of the Department of Aeronautical Engineering. On the other hand, Biological Science and Comparative Literature are major fields for which there are no corresponding departments. In such cases a committee of the Graduate School is responsible for administering the program. In some cases a single department offers work in more than one field. Thus the Department of Civil Engineering offers work in both Civil and Sanitary Engineering.

Applicants for admission are encouraged to consult the person whose name is listed under the major field heading.

DOCTORAL DEGREES—Those major fields in which a doctorate is offered are identified by a dagger (†). Both the D.Ed. and the Ph.D. may be offered at the discretion of the department or the committee in charge. The specific requirements for the two degrees are, of course, different. Details are given in the preceding section.

MASTERS' DEGREES—An asterisk (*) indicates that only the master's degree is available in the field. A dagger (†) indicates that the doctorate as well as the master's degree may be conferred. In the academic programs the degree is either M.A. or M.S., depending upon the field. The M.Ed. degree is, in general, available in those fields approved for the master's degree if such a professional program is appropriate in that field.

Special and rather restricted programs lead to the Master of Forestry, the Master of Public Administration, and the Master of Science in Nutrition and Public Health.

MINOR FIELDS—All major fields listed are also acceptable as minors. In addition, a few fields in which no advanced degrees are offered have been approved as minors for candidates who are majoring in related areas. Such minor fields are identified by a brief statement under the field heading.

A candidate's choice of minor field depends upon the particular degree he is seeking and is subject to the approval of his major department. The requirements in each minor field are established by the minor department subject to the regulations of the Graduate Faculty.

OTHER FIELDS—Fields which have not been approved for either major or minor work at this institution, but in which approved courses are offered, are listed in Part II of this section. These courses may be used in graduate programs as electives or as part of a general studies program, subject to the approval of the major department and to the restrictions upon the use of 400 series courses in degree programs.

GRADUATE COURSES

Courses are listed under the heading of a field of study. The fields are in alphabetical order. In most cases the name of the course is the same as the name of the field. Thus courses in the field of Aeronautical Engineering, offered by the Department of Aeronautical Engineering, are designated as Aero.E. 501, etc. Exceptions are noted at the appropriate places.

NUMBERING SYSTEM—Courses in the series 1-399 are not listed in this bulletin because they are strictly undergraduate courses and yield no graduate credit. A graduate student may register for or audit these courses in order to make up deficiencies or fill in gaps in his earlier education but not to meet requirements for an advanced degree.

Courses in the series 400-499 are for upperclassmen with at least junior standing and for graduate students. Only a limited number of credits earned in these courses may be counted toward the requirements for an advanced degree. Detailed regulations are given in the preceding section of this bulletin.

Courses in the series 500-599 are restricted to students registered in the Graduate School and other students who, in exceptional cases, have been granted permission to enroll by the Dean of the Graduate School.

Course numbers 600 and 610 apply to research and thesis and are available only to students registered in the Graduate School.

COURSE DESCRIPTIONS—A course abbreviation, a number, and a title designate each course. Official abbreviations are given on page 48. The figures in parentheses following the course title show the number of credits which may be granted for that course. In the case of courses with variable credits, the number of credits which may be earned in a single semester or session is determined by the department offering the course.

A department may schedule an entire section of a course below the 400 level for fewer credits than the maximum authorized. In 400 and 500 series courses a department may schedule an individual student for fewer credits than the maximum number but in no case for more than the maximum number authorized.

The letter "X" following a course number indicates that the course is approved for extension classes. The letter "S" following a course number indicates that the course is approved only for summer sessions and not for the academic year. The letter "V" following a course number indicates a vocational education course.

In many cases the name of the instructor who usually teaches the course is listed after the course description.

SCHEDULE OF COURSES—Not all courses are given each semester or session. A complete list of the courses which will be offered in any specific semester is given in the *Timetable*, which is available at nominal cost from the Registrar's Office a few weeks before the beginning of each semester. The *Timetable* gives the number of credits being offered in each course, the hours at which the class will meet, the location of the class, and in some cases the instructor's name.

The courses being offered during a specific summer session are given in the *Complete Announcement of the Summer Sessions* for that year. This announcement, which includes a timetable for summer sessions classes, may be obtained from the Summer Sessions office a few weeks before the beginning of the first session.

RESEARCH AND THESIS

The list of courses given in the *Timetable* and the *Complete Announcement of the Summer Sessions* is subject to modification at registration time. The number enrolling in a course, the availability of staff members, and other circumstances may result in the cancellation of some courses and the offering of others. Decisions are made by the departments offering the courses.

RESEARCH AND THESIS WORK—In general, students registering for research or for work on a master's or a doctor's thesis will, if it is to be done in residence, use course number 600 preceded by the appropriate course abbreviation. Thus Aero.E. 600 signifies research or thesis in Aeronautical Engineering. In case such work has been authorized as off-campus work for nonresident students, the number 610 will be used. Credits will be 1 to 15 per semester.

It should be understood that the numbers 600 and 610 are available in all fields in which majors have been approved for advanced degrees although these numbers do not appear in the course lists of the individual departments either in this bulletin or in the timetables for the academic year.

During the summer sessions, however, the research and thesis work is usually available only in the fields which list the 600 and 610 numbers in the *Complete Announcement* and the *Summer Sessions Timetable* for that particular year.

COURSE ABBREVIATIONS

Acctg.	Accounting	Greek	Greek
Aero.E.	Aeronautical Engineering	Hl.Ed.	Health Education
A.B.Ch.	Agricultural and Biological Chemistry	Hist.	History
Agr.Ec.	Agricultural Economics	H.Art	Home Art
Agr.Ed.	Agricultural Education	H.C.Rel.	Home-Community Relationships
Agr.E.	Agricultural Engineering	H.E.Ed.	Home Economics Education
Agr.	Agriculture—General	H.Mgmt.	Home Management and Family Economics
Agro.	Agronomy	Hort.	Horticulture
A.H.	Animal Husbandry	Hl.Adm.	Hotel Administration
A.Ntr.	Animal Nutrition	Hs.Eqp.	Housing and Home Equipment
Anthy.	Anthropology	I.Arts	Industrial Arts
Archy.	Archaeology	Ind.Ed.	Industrial Education
A.E.	Architectural Engineering	I.E.	Industrial Engineering
Arch.	Architecture	In.Adm.	Institution Administration
Art	Art	Int.Un.	International Understanding
Art Ed.	Art Education	It.	Italian
Astro.	Astronomy	Journ.	Journalism
Bact.	Bacteriology	Latin	Latin
Bot.	Botany	Math.	Mathematics
B.Stat.	Business Statistics	M.E.	Mechanical Engineering
Cer.T.	Ceramic Technology	Met.	Metallurgy
Ch.E.	Chemical Engineering	Meteo.	Meteorology
Chem.	Chemistry	Min.Ec.	Mineral Economics
Ch.Fm.	Child Development and Family Relationships	M.I.	Mineral Industries
C.E.	Civil Engineering	Min.Pr.	Mineral Preparation
Cl.Tex.	Clothing and Textiles	Min.Sc.	Mineral Sciences
Com.	Commerce	Min.	Mineralogy
C.Con.S.	Commercial Consumer Services	Mng.	Mining
C.Lit.	Comparative Literature	Music	Music
D.Sc.	Dairy Science	Mus.Ed.	Music Education
Dram.	Dramatics	Pet.E.	Petroleum and Natural Gas
Econ.	Economics	Phil.	Philosophy
Ed.	Education	Ph.Ed.	Physical Education
E.E.	Electrical Engineering	Phys.	Physics
El.Lab.	Electrical Engineering Laboratory	Pol.S.	Political Science
Eng.	Engineering	Port.	Portuguese
Mchs.	Engineering Mechanics	P.H.	Poultry Husbandry
Engl.	English	Psy.	Psychology
E.Cmp.	English Composition	P.U.	Public Utilities
E.Lit.	English Literature	Rec.Ed.	Recreation Education
Ent.	Entomology	Rom.Lt.	Romance Literature
Fd.Ntr.	Foods, Nutrition, and Health	Rom.Ph.	Romance Philology
For.	Forestry	R.Soc.	Rural Sociology
Fr.	French	Rus.	Russian
Fuel T.	Fuel Technology	Soc.	Sociology
Gen.H.E.	General Home Economics	Sp.	Spanish
Geog.	Geography	Spch.	Speech
Geol.	Geology	Sph.Ed.	Speech Education
G.G.	Geophysics and Geochemistry	Vet.Sc.	Veterinary Science
Ger.	German	Zool.	Zoology

Part I

Courses in Major and Minor Fields

AERONAUTICAL ENGINEERING †

PROFESSOR HAROLD M. HIPSH, *Head of the Department*

- 401a,b,c. AERONAUTICAL ENGINEERING PROJECTS (2-12)
402. DESIGN AND TESTING OF AIRCRAFT ENGINE COMPONENTS (3)
403. APPLIED AERODYNAMICS (3)
404. AIRPLANE DESIGN AND TESTING (3)
407. ROTARY WING AIRCRAFT (3)
408. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3)
409. AIRCRAFT STRUCTURAL DETAIL DESIGN (3)
410. AIRCRAFT PROPULSION (3)
411. AEROELASTICITY (3)
412. THEORETICAL AERODYNAMICS (3)
413. GUIDED MISSILES (3)
414. AIRCRAFT PRELIMINARY DESIGN (3)
415. ADVANCED THEORETICAL AERODYNAMICS (3)
416. MISSILE SYSTEMS LECTURES (0)
417. MISSILE SYSTEMS LECTURES (0)
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501. AIRPLANE STABILITY AND CONTROL (3) General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aero.E. 403.
503. AIRPLANE PERFORMANCE (3) Methods of performance prediction and performance flight testing for high-speed aircraft and missiles. Prerequisite: Aero.E. 403.
504. ROTARY WING AIRCRAFT (3) Types of rotary wing aircraft; helicopter performance, stability, and control; structural and vibration problems. Prerequisites: Aero.E. 403, 409.
505. AIRCRAFT VIBRATION AND FLUTTER (3) Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending, torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aero.E. 1, M.E. 54.
506. ADVANCED AIRCRAFT STRUCTURES (3) Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing deformations of multi-cell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisite: Aero.E. 409.
507. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3) Types of jet propulsion installations, thermodynamic cycles, analysis of compressors, combustion chambers, and turbines. Prerequisite: Aero.E. 410.
510. AERODYNAMICS OF COMPRESSIBLE FLUIDS (3) One-dimensional motion, shock waves, flow in nozzles, two-dimensional flow, airfoil theory, Prandtl-Meyer flow, method of characteristics. Prerequisite: Aero.E. 412.

AERONAUTICAL ENGINEERING

511. AERODYNAMICS OF A PERFECT FLUID (3) Euler's dynamic equations, complex potential, conformal transformation, thin airfoils, Biot-Savart law; Prandtl three-dimensional airfoil theory. Prerequisite: Aero.E. 412.
512. AERODYNAMICS OF A VISCOUS FLUID (3) Navier-Stokes equations, incompressible and compressible boundary layer theory, jet and wake problems, hydrodynamic stability, turbulence. Prerequisite: Aero.E. 412.
513. RESEARCH IN AERONAUTICAL ENGINEERING (1-15 per semester) Investigation of a theoretical or experimental project in aeronautical engineering.
514. AERONAUTICAL ENGINEERING SEMINAR (1 per semester) Current literature and special problems in aeronautical engineering.
515. AERODYNAMICS (3) Airflow, airplane performance. For students with undergraduate training in science or engineering curriculums other than aeronautical engineering.
516. AIRCRAFT STRUCTURES (3) Analysis of semi-monocoque aircraft structures. For students with undergraduate training in science or engineering curriculums other than aeronautical engineering.

AGRICULTURAL AND BIOLOGICAL CHEMISTRY †

PROFESSOR HOWARD O. TRIEBOLD, *Head of the Department*

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| 403. DAIRY CHEMISTRY (3) | <i>Mr. Shigley</i> |
| 404. FOOD CHEMISTRY (4) | <i>Mr. Triebold</i> |
| 413. PRINCIPLES OF ANIMAL NUTRITION (3) | <i>Mr. Miller</i> |
| 417. METHODS OF AGRICULTURAL ANALYSIS (4) | <i>Mr. Triebold</i> |
| 418. PLANT ANALYSIS (4) | |
| 421. CHEMISTRY OF MILLING AND BAKING (3) | <i>Mr. Triebold</i> |
| 425. BIOPHYSICAL CHEMISTRY (4) | <i>Mr. Mallette</i> |
| 426. BIOCOLLOIDS (3) | <i>Mr. Mallette</i> |
| 427. POTENTIOMETRIC THEORY AND TECHNIQUE (3) | |
| 437. GENERAL BIOCHEMISTRY (5) | <i>Mr. Pritham</i> |
| 438. PHYSIOLOGICAL CHEMISTRY (CLINICAL METHODS) (5) | <i>Mr. Pritham</i> |
| 439. PROBLEMS IN AGRICULTURAL CHEMISTRY (3-5) | |
| 440. PLANT BIOCHEMISTRY (3) | |
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| 501. ENZYMES (2) Investigations and theories concerning nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: A.B.Ch. 437. | |
| 502. PHYSICAL CHEMISTRY OF THE CELL (3) Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: A.B.Ch. 426. | |
| 503. BIOCHEMICAL PROBLEMS (1-10 per semester) Prosecution of an assigned problem under the guidance of an instructor. | |
| 505. VITAMINS AND DIETARY DEFICIENCY DISEASES (2) Lectures, conferences, and assigned reading. Prerequisite: A.B.Ch. 437. | <i>Mr. Guerrant</i> |

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

506. VITAMIN ASSAY METHODS (2) Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: A.B.Ch. 505.
Mr. Guerrant
- 507a. SEMINAR IN PHYSIOLOGICAL CHEMISTRY AND NUTRITION (1 per semester)
Messrs. Guerrant, Boucher, Miller, and Pritham
- 507b. SEMINAR IN FOODS AND ANALYTICAL CHEMISTRY (1 per semester)
Messrs. Triebold, Althouse, and Shigley
- 507c. SEMINAR IN PLANT, ENZYME, AND INSECTICIDE CHEMISTRY (1 per semester)
Messrs. Frear, Benson, and Mallette
508. BIOCHEMICAL LITERATURE (1-3) Assigned readings, reports, and conferences on selected topics in biochemistry. Prerequisite: A.B.Ch. 437.
510. PROTEINS (2) Chemical constitution of proteins, their physical and biochemical properties, their function in nutrition, and their fate in metabolism. Prerequisite: A.B.Ch. 437.
Mr. Mallette
511. CARBOHYDRATES (2) Chemical constitution and properties of carbohydrates; their metabolism in plant and animal organisms. Prerequisite: A.B.Ch. 437.
Mr. Benson
512. LIPIDS (2) Investigations on biochemistry of fats and related substances.
Mr. Althouse
513. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (4) Laboratory course, quantitative in nature, valuable as preparation for A.B.Ch. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: A.B.Ch. 425 or Chem. 463.
515. BIOMETRY (2) Application of statistical methods to research problems in biochemistry and biology. Prerequisite: Agr. 400.
Mr. Miller
516. CHEMISTRY OF THE PESTICIDES (2) Lectures and assigned readings on the chemistry of insecticides, fungicides, herbicides, rodenticides, and related materials. Prerequisite: Chem. 31 or A.B.Ch. 437.
Mr. Frear
517. ENDOCRINE SECRETIONS (2) Chemistry of hormones and their physiological significance. Prerequisite: A.B.Ch. 437.
Mr. Pritham
518. MINERAL METABOLISM (2) Utilization and function of mineral elements in animal nutrition. Prerequisite: A.B.Ch. 437.
Mr. Boucher

AGRICULTURAL ECONOMICS †

PROFESSOR MACKLIN E. JOHN

Head of the Department of Agricultural Economics and Rural Sociology

- 400, 400X. PUBLIC POLICIES IN AGRICULTURE (1-2)
407. ADVANCED FARM MANAGEMENT (3)

AGRICULTURAL ECONOMICS

420. AGRICULTURAL PRICES (3) *Mr. Brandow*
421. LAND ECONOMICS (3) *Mr. Frey*
426. (A.H. 426). LIVESTOCK MARKETING (3) *Mr. Trotter*
440. ECONOMICS OF AGRICULTURAL PRODUCTION (3)
500. SEMINAR IN AGRICULTURAL ECONOMICS (1-6) Review of current literature and problems.
503. RESEARCH METHODS IN FARM MANAGEMENT (1-3) Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Agr.Ec. 6, Econ. 14.
504. AGRICULTURAL PRICE AND INCOME POLICY (3) Analysis of farm prices, income consequences for producers and consumers, and effects on resource use; evaluation of policy, considerations in policy making. Prerequisites: Agr.Ec. 420, Econ. 405. *Mr. Brandow*
505. ADVANCED AGRICULTURAL STATISTICS (3) Multiple correlation, curve fitting, analysis of variance, selection of samples, and other techniques applicable to the rural social sciences. Prerequisite: 3 credits in statistics. *Mr. Brandow*
506. ECONOMIC PROBLEMS IN MARKETING SPECIFIC AGRICULTURAL PRODUCTS (1-4)
507. SEMINAR IN FARM MANAGEMENT (1-6) Special problems relating to organization and operation of the farm business. Prerequisites: Agr.Ec. 6, Econ. 14.
508. CURRENT LITERATURE SEMINAR IN ECONOMICS OF AGRICULTURAL MARKETING (1-3)
510. ADVANCED FARM FINANCE (1-3) Problems and policies in agricultural credit, insurance, and farm financial management.
515. ECONOMIC PROBLEMS IN THE MARKETING OF DAIRY PRODUCTS (3) Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing. *Mr. Pierce*
517. PROBLEMS AND POLICIES OF FARMER CO-OPERATIVES (3) Specific types of co-operative organizations, their problems, policies, and progress; relationships existing among co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Agr.Ec. 17. *Mr. Becker*
520. FARM PRICE ANALYSIS (3) Econometric analysis of prices, production, and utilization of farm products; review of research in this field. Prerequisites: Agr.Ec. 420, 505; Econ. 405.
522. ADVANCED FARM APPRAISAL (3) Land value theory; methods of land valuation; field practice in farm appraisal.
525. RESEARCH METHODS IN RURAL SOCIAL SCIENCES (2) Scientific method in planning and conducting research. Prerequisite: 9 credits in social sciences. *Mr. John*
526. RESEARCH METHODS IN AGRICULTURAL ECONOMICS (3) Application of economic and statistical principles. *Mr. Baker*

AGRICULTURAL EDUCATION †

PROFESSOR HENRY S. BRUNNER, *Head of the Department*

- 416v. RURAL EDUCATION (3) *Mr. Hall*
 417v, 417vX. RURAL EDUCATION SURVEY (2) *Mr. Brunner*
 418v, 418vX. SURVEY OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Mr. Brunner*
 420v, 420vX. ADVANCED VISUAL AND OTHER SENSORY AIDS IN TEACHING AGRICULTURE (1-6) *Mr. Brunner*
 422v, 422vX. SUPERVISION OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3)
 434v, 434vX. AGRICULTURAL DEVELOPMENTS (1-6)
 501v. HISTORY OF AGRICULTURAL EDUCATION (1-3) Development of training for agricultural vocations; emphasis upon introduction of agricultural instruction into the high school program. *Mr. Hall*
 502v, 502vX. TEACHING VOCATIONAL AGRICULTURE (1-3) Organization of instruction with respect to vocational objectives, methods of presentation, supervision of practice, pupil evaluation of goals, and follow-up. *Mr. Stevens*
 503v, 503vX. RESEARCH IN AGRICULTURAL EDUCATION (1-6 per semester) Individual study problems in various phases of agricultural education, such as evaluation of teaching, teaching procedures, and teacher preparation. *Mr. Brunner and Staff*
 504v. AGRICULTURAL EDUCATION SEMINAR (1 per semester) *Mr. Brunner and Staff*
 506v, 506vX. PROBLEMS IN COUNTY VOCATIONAL SUPERVISION (1-3) Needs of county supervisors and vocational directors; co-operation with county superintendents, supervisory duties, plans of work, community meetings and organizations.
 508v. STATE AND COUNTY ADMINISTRATION AND SUPERVISION OF AGRICULTURAL EDUCATION (1-3) Organization and administration of state, county, township, and district systems of agricultural education; state and federal legislation.
 509v, 509vX. TEACHER TRAINING IN AGRICULTURAL EDUCATION (1-6) Construction of college curriculums, courses of study, and organization of college departments for training agricultural teachers. *Mr. Brunner*
 520v, 520vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Methods of procedure in investigation and experimentation in education, accompanied by a critical examination of studies made in agricultural education. *Mr. Stevens*
 521v, 521vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Continuation of Agr.Ed. 520v; emphasis upon statistical techniques for students' individual problems. *Mr. Stevens*
 522v, 522vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) Organization and administration of agricultural education in its local bearings; field laboratory surveys of local school conditions. *Mr. Brunner and Staff*
 523v, 523vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) *Mr. Brunner and Staff*
 524v, 524vX. ANNUAL PLAN OF WORK (1-3) Detailed study of the agricultural education needs of each student's community and outlining annual plans of work. *Mr. Brunner*

AGRICULTURAL EDUCATION

- 530v. AGRICULTURAL COLLEGE TEACHING (3) Selection and organization of subject matter for specific courses, methods of learning, teaching devices, technique of teaching, and measurements of results of teaching. *Mr. Brunner*

AGRICULTURAL ENGINEERING *

PROFESSOR FRANK W. PEIKERT, *Head of the Department*

400. AGRICULTURAL ENGINEERING PROBLEMS (1-7)
- 401S. FARM MECHANICS FOR TEACHERS OF VOCATIONAL AGRICULTURE (1½-9)
- Unit A. Farm Utilities (1½)*
- Unit B. Farm Mechanics (1½)*
- Unit C. Farm Engines (1½)*
- Unit D. Farm Machinery (1½)*
- Unit E. Farm Buildings (1½)*
- Unit F. Soil and Water Structures (1½)*
402. FUNCTIONAL DESIGN OF FARM STRUCTURES (3)
405. ADVANCED FARM ELECTRIFICATION (3)
406. ADVANCED DAIRY ENGINEERING (3)
500. ADVANCED ELECTRO-AGRICULTURE (1-6) Investigations in the application of electrical energy to processing, storing, and handling agricultural products. Seminar, written reports.
501. ADVANCED FARM MACHINERY (1-6) Application of agricultural engineering principles to design and operation of farm machinery. Prerequisite: Agr.E. 110.
508. ADVANCED PROBLEMS IN FARM MECHANICS (1-15) Problems in farm shop practice and agricultural engineering related to the farm mechanics program of vocational education in agriculture. Prerequisites: Agr.E. 8, 14; or teaching experience in farm mechanics.
509. RESEARCH IN AGRICULTURAL ENGINEERING (1-4)

AGRONOMY †

PROFESSOR HOWARD B. SPRAGUE, *Head of the Department*

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| 411. BREEDING OF FIELD CROPS (3) | <i>Mr. Cleveland</i> |
| 416. SOIL CLASSIFICATION (5) | <i>Mr. Higbee</i> |
| 419. SOIL PROPERTIES (5) | <i>Mr. Merkle</i> |
| 422. SOIL CONSERVATION (3) | <i>Mr. Kardos</i> |
| 423. PASTURE AND GRASSLAND MANAGEMENT (3) | <i>Mr. Washko</i> |
| 424. FERTILIZER TECHNOLOGY (3) | <i>Mr. Marriott</i> |
| 429. (Bot. 429). WHITE POTATO PRODUCTION (3) | <i>Messrs. Cobb and Mills</i> |
| 490. AGRONOMIC PRACTICES (1-6) | <i>Mr. Washko and Staff</i> |

501. **ADVANCED SOIL FERTILITY** (4) Interpretation of fertility experiments and diagnosis of soil-plant relationships through field appraisal, analysis, and plant symptoms. Prerequisites: Agro. 31, Bot. 406. *Mr. Merkle*
503. **AGRONOMY SEMINAR** (1) Weekly meeting where papers and discussions will be presented by students and staff members. *Mr. H. B. Sprague*
506. **SOIL CHEMISTRY** (4) Analyses of important chemical and biochemical reactions occurring in soils, conditions which control these reactions and their importance in soil genesis and plant growth; laboratory work in the more typical and significant analytical procedures; lectures, review of current literature, and practicum. Prerequisites: Agro. 419; A.B.Ch. 417 or Chem. 20. *Mr. Satchell*
507. **SOIL PHYSICS** (4) Physical properties of the soil; factors affecting them; their measurements, evaluation, and influence in determination of soil productivity. Prerequisites: Agro. 419, Phys. 215, A.B.Ch. 425. *Mr. Kardos*
509. **GENETICS OF CROP PLANTS** (3) Inheritance in crop plants with particular reference to factor interaction, genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 422. *Mr. Cleveland*
510. **THE APPLICATION OF CYTOGENETICS TO PLANT BREEDING** (3) Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 422. *Mr. Cleveland*
512. **FIELD PLOT TECHNIQUE** (4) Ramifications of analysis of variance technics; combining and analyzing data from several experiments; selection of valid error terms. Prerequisite: Math. 8 or Agr. 400. *Mr. Fortmann*
516. **HUMUS** (2) Origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 31, 419. *Mr. Richer*
517. **FARM CROPS ECOLOGY** (2) Ecological factors influencing distribution and production of field crops. Prerequisites: Math. 8, Bot. 406. *Mr. Huber*
518. **GROWTH AND MANAGEMENT OF FORAGE CROPS** (3) Factors affecting growth and development of forage crops with particular reference to effects of environment, defoliation, and management practices. Prerequisites: Agro. 423, Bot. 406. *Mr. V. G. Sprague*
519. **THE NATURE OF SOIL MINERALS** (3) Modern methods for identification of the constituent minerals of soils and their relation to soil classification and agricultural practices. Prerequisites: Agro. 1, Chem. 2, Geol. 31. *Mr. Jeffries*
520. **SPECIAL SOILS PROBLEMS** (1-6 per semester) Provides basic or practical training in the soils sciences by means of library, field, and laboratory assignments.
545. **THE APPLICATION OF STATISTICS TO FIELD EXPERIMENTS** (4) Use of advanced experimental designs in planning, analyzing, and interpreting experiments; includes lattice designs, factorials, confounding, simple and multiple covariance techniques. Prerequisite: Agro. 512. *Mr. Fortmann*
550. **SPECIAL CROPS PROBLEMS** (1-6 per semester) Provides basic or practical training in the crops sciences by means of library, field, and laboratory assignments.
582. **SEMINAR IN THE BREEDING AND GENETICS OF FARM CROPS** (1-8 per semester)
- 583S. **LABORATORY METHODS IN AGRONOMIC RESEARCH** (3) Prerequisite: Agro. 512.

ANIMAL HUSBANDRY †

PROFESSOR GLENN R. KEAN, *Acting Head of the Department*

421. ADVANCED MEAT STUDIES (3) Mr. Ziegler
423. ADVANCED STOCK JUDGING (2)
424. ANIMAL HUSBANDRY SEMINAR (1)
426. (Agr.Ec. 426). LIVESTOCK MARKETING (3)
431. ADVANCED MEAT JUDGING (2)
500. SEMINAR IN ANIMAL HUSBANDRY (1-6)
501. PEDIGREE STUDY (1-6) Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book.
502. RESEARCH IN MEATS (1-6 per semester) Investigation of methods for handling, cutting, processing, freezing, and curing meat and meat products. Prerequisite: A.H. 421. Mr. Ziegler
503. LIVESTOCK MANAGEMENT (3) Handling of purebred herds and flocks; relation of livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding.
505. ADVANCED ANIMAL BREEDING (1-5) Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22.

ANIMAL NUTRITION †

PROFESSOR RAYMOND W. SWIFT, *Head of the Department*

The Master of Science and Doctor of Philosophy degrees are offered with a major in Animal Nutrition. Candidates select courses for this major from a number of related fields.

401. PHYSIOLOGY OF NUTRITION (3) Mr. Barron
402. PHYSIOLOGY OF NUTRITION (3) Mr. French

ANTHROPOLOGY

PROFESSOR WILLIAM G. MATHER, *Head of the Department of Sociology*

No advanced degree is offered in this field, but a candidate with a major in another field may choose a minor in Anthropology with the approval of his major department.

441. FOLK SOCIETY (3) Mr. Mook
443. ANTHROPOLOGY OF THE OLD WORLD (3) Mr. Mook
445. PRIMITIVE SOCIETY (3) Mr. Mook

540. THEORY AND METHOD IN ANTHROPOLOGY (3) Theory and method used in culture-historical, sociological, and psychological interpretations. *Mr. Mook*
545. SEMINAR IN ANTHROPOLOGY (1-9) Critical analysis of research in selected areas of regional ethnography and ethnological theory. Prerequisites: Anthy. 45, 445. *Mr. Mook*

ARCHITECTURAL ENGINEERING *

Consult PROFESSOR LOUIS A. RICHARDSON

401. ARCHITECTURAL ENGINEERING (3)
402. ARCHITECTURAL ENGINEERING (4)
403. ARCHITECTURAL ENGINEERING (3)
420. ARCHITECTURAL ENGINEERING (3)
421. ARCHITECTURAL ENGINEERING (4)
422. ARCHITECTURAL ENGINEERING (3)
423. ARCHITECTURAL ENGINEERING THESIS (2)
424. ARCHITECTURAL ENGINEERING THESIS (5)
502. ARCHITECTURAL ENGINEERING (3-8) Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar. *Mr. Richardson and Staff*
503. ARCHITECTURAL ENGINEERING (4-8) Continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed constructions are studied. Practicum and seminar. *Mr. Richardson and Staff*
504. ARCHITECTURAL ENGINEERING (4-8) Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar. *Mr. Richardson and Staff*

ARCHITECTURE *

PROFESSOR MILTON S. OSBORNE, *Head of the Department*

410. ADVANCED ARCHITECTURAL DESIGN (2-12) *Mr. Osborne and Staff*
411. ADVANCED ARCHITECTURAL DESIGN (8)
412. ADVANCED ARCHITECTURAL DESIGN AND THESIS (8)
421. CONTEMPORARY ARCHITECTURE (3)
501. ARCHITECTURAL DESIGN (4-8) Problems in advanced planning and design, including study of group composition. Practicum and seminar. *Mr. Osborne and Staff*
502. ARCHITECTURAL RESEARCH (2-12) Prosecution of assigned problems under the guidance of an instructor. *Mr. Osborne and Staff*
503. ARCHITECTURAL HISTORY RESEARCH (3-12) Original research in architectural history. Seminar and written reports. *Mr. Dickson and Staff*

ART EDUCATION †

PROFESSOR VIKTOR LOWENFELD, *Head of the Department*

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| 402. PROFESSIONAL ORIENTATION OF THE ART TEACHER (3) | <i>Mr. Mattil</i> |
| 404. METHODS OF GRAPHICS AND ILLUSTRATIONS (3) | <i>Miss Emerson</i> |
| 414, 414X. ADVANCED CRAFTS FOR TEACHERS (3-6) | <i>Mr. Beittel</i> |
| 420. CERAMICS FOR TEACHERS (3) | |
| 434, 434X. ART APPRECIATION IN THE EDUCATIONAL PROGRAM (3) | <i>Mr. Beittel</i> |
| 434b, 434bX. ART IN THE ELEMENTARY SCHOOL (2-3) | <i>Mr. Lowenfeld</i> |
| 434c, 434cX. ART IN THE SECONDARY SCHOOL (3) | <i>Mr. Mattil</i> |
| 434d. ART SUPERVISION (3) | <i>Mr. Mattil</i> |
| 486, 486X. CURRENT PROBLEMS IN ART EDUCATION (2-3) | <i>Mr. Mattil</i> |
| 487. MURAL PAINTING IN SCHOOLS (3) | <i>Mr. Lowenfeld</i> |
| 488. ADVANCED MURAL PAINTING IN SCHOOLS (3) | <i>Mr. Lowenfeld</i> |
| 489. ART EXPERIENCES WITH CHILDREN (3) | |
| 504. ADVANCED METHODS IN GRAPHIC PROCESSES (3) Exploration through laboratory experience of printing method; etching, silk screen, linoleum, or other. Applications in teaching. | |
| 514. FUNCTIONAL RELATIONSHIPS IN CRAFTS (3) Relationships of material design and purpose in crafts discussed by means of outstanding products of different materials, periods, and cultures. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts. | |
| <i>Miss Emerson</i> | |
| 516. ANALYSIS OF THREE-DIMENSIONAL PROCESSES IN ART (3) Three-dimensional processes analyzed with regard to kinetic, textural, form, and other functions. | |
| 534. CREATIVE ART ACTIVITY FOR THE HANDICAPPED (3) Specific methods for development of creative art activity with the physically, mentally, emotionally, and socially handicapped; adjustive effect upon them. Prerequisite: 6 credits in art education or 6 in special education or 6 in psychology. | |
| <i>Mr. Lowenfeld</i> | |
| 586. RESEARCH IN ART EDUCATION (3-9) Current experiments in art education; required of students working for a master's degree in art education. | |
| <i>Mr. Beittel</i> | |
| 588. HISTORY OF ART EDUCATION (3) Historical development of philosophies in art education in the United States and abroad. | |

BACTERIOLOGY †

PROFESSOR ROBERT W. STONE, *Head of the Department*

- 401. GENERAL MICROBIOLOGY (4)
- 407. BACTERIOLOGY PROBLEMS (2-9)
- 410. IMMUNOLOGY AND SEROLOGY (4)
- 411. BACTERIOLOGICAL SURVEY (1)
- 412. ADVANCED BACTERIOLOGY (4)
- 413. SOIL MICROBIOLOGY (3)
- 414. FOOD MICROBIOLOGY (4)
- 416. INDUSTRIAL MICROBIOLOGY (4)

506. RESEARCH (1-15 per semester) Special problems in microbiology.
507. SEMINAR (1 per semester) Reports on current fields of research.
508. PHYSIOLOGY OF BACTERIA (2) Composition, nutrition, and growth of microorganisms; influence of physical and chemical environment on metabolism.
- 508a. LABORATORY IN PHYSIOLOGY OF BACTERIA (2) Laboratory work to accompany the lectures given in Bact. 508.
509. FERMENTATION (2) Chemical activities of microorganisms; mechanisms of fermentative and oxidative metabolism.
510. LABORATORY IN FERMENTATION (2) Laboratory procedures and problems in fermentation to accompany Bact. 509.
512. BACTERIOLOGICAL TECHNIQUES (1-6) Practice in special laboratory techniques including manometry, tissue culture, and serology.
515. (Vet.Sc. 515). VIROLOGY (2-4) Rickettsial and viral agents parasitizing man, animals, and microorganisms. Prerequisite: Bact. 410.
516. BACTERIAL GENETICS (2-4) Mechanisms of variation in microorganisms including mutation, adaptation, sexual recombination, transduction, and transforming factors. Prerequisite: 3 credits each in bacteriology and genetics.

BIOLOGICAL SCIENCE *

Consult PROFESSOR HENRY W. POPP

The Master of Education degree is offered with a major in Biological Science. The program, which is designed to meet the needs of secondary school science teachers, consists of at least 24 credits chosen from bacteriology, agricultural and biological chemistry, botany, and zoology, and a minor of at least 6 credits in basic education. A candidate is expected to complete at least one course in each of the four sciences and at least 12 credits in one of them.

The Master of Science degree is offered in agricultural and biological chemistry, bacteriology, botany, entomology, and zoology, but not in the broad field of biological science.

BOTANY †

PROFESSOR HENRY W. POPP, *Head of the Department*

405. (Zool. 405). GENERAL CYTOLOGY (3)
406. PLANT PHYSIOLOGY (4)
407. PLANT ANATOMY (3)
408. PLANT PATHOLOGICAL TECHNIQUES (3)
409. PLANT ECOLOGY (3)

Mr. Kribs

Mr. Kovar

412. ADVANCED FOREST PATHOLOGY (3) *Mr. Fergus*
 414, 414X. TAXONOMY OF VASCULAR PLANTS (3) *Mr. Wahl*
 415. MORPHOLOGY OF THE ALGAE (3) *Mr. Wahl*
 416. MORPHOLOGY OF THE BRYOPHYTES (2) *Mr. Grove*
 417. MORPHOLOGY OF THE TRACHEOPHYTA EXCLUSIVE OF ANGIOSPERMS (3) *Mr. Grove*
 418. BOTANICAL PROBLEMS (1-6) *Mr. Popp and Staff*
 419. MYCOLOGY (3) *Mr. Fergus*
 420. MORPHOLOGY OF THE ANGIOSPERMS (3) *Mr. Grove*
 421. BOTANICAL TECHNIQUE (3) *Mr. Grove*
 422. (Zool. 422). ADVANCED GENETICS (3) *Mr. Wright*
 424. COMMERCIAL TROPICAL WOODS (3) *Mr. Kribs*
 427. ADVANCED SYSTEMATIC BOTANY (1-6) *Mr. Wahl*
 428. ADVANCED PLANT PATHOLOGY (2)
 429. (Agro. 429). WHITE POTATO PRODUCTION (3) *Mr. Mills*
 433S. (Zool. 433S). GENETICS, EUGENICS, AND EVOLUTION (3)
 500. PLANT PHYSIOLOGY SEMINAR (1 per semester) Selected topics from recent literature; staff and student reports on current research. *Mr. Popp*
 501. THE PHYSIOLOGY OF THE FUNGI (3) Chemical composition, metabolism, toxic and stimulating agencies, spore germination, growth and irritability of the fungi. Prerequisites: Bot. 406, 419, and preferably Chem. 32. *Mr. Fergus*
 505. (Zool. 505). CYTOLOGY AND CYTOGENETICS (3) Structure and function of the cell and components; growth, differentiation, reproduction; chromosome mechanism of heredity; cytological and cytochemical techniques; cytology in study of evolution. Prerequisite: Bot. 22 or Zool. 22. *Mr. Grun*
 506. COMPARATIVE ANATOMY OF VASCULAR PLANTS (3) Structure of the Tracheophyta from a phylogenetic standpoint. Prerequisite: Bot. 407. *Mr. Kribs*
 508. PROBLEMS IN GENETICS (2-6) Problems to suit needs of individual students; conferences and laboratory work. Prerequisite: Bot. 422. *Mr. Wright*
 509. PHYSIOLOGY OF PATHOGENICITY (3) Physiological processes of plant pathogenic bacteria and fungi occurring during incubation, ingress, and infection. Prerequisite: Bot. 10, 11, or 419.
 511. PHYSIOLOGY OF PLANT GROWTH AND DEVELOPMENT (2-4) Prerequisite: Bot. 406. *Mr. Popp*
 512. PHYSIOLOGY OF PLANT METABOLISM (2-4) Prerequisite: Bot. 406.
 513. WATER AND MINERAL RELATIONS OF PLANTS (2-4) Absorption of water and minerals; transport of materials within the plant; physiology of transpiration. Prerequisite: Bot. 406.
 515. DISEASE RESISTANCE IN PLANTS (2-4) Stability of resistance, selection of resistant material, economics of control, special problems. Prerequisites: Bot. 22 or 33; 10. *Messrs. Wernham and Mills*
 518. BOTANICAL PROBLEMS (1-15 per semester) *Mr. Popp and Staff*
 519. PLANT VIRUSES (3) Nature, symptomatology, transmission, and control of virus diseases of plants. *Mr. Boyle*

520. PLANT PATHOGENIC BACTERIA (3) Bacteria causing plant diseases, methods of identification, inoculation and control. *Mr. Kneebone*
521. MOLDS, YEASTS, AND ACTINOMYCETES (3) Morphology and taxonomy of fungi important in microbiology; identification and techniques of study.
522. MYXOMYCETES, PHYCOMYCETES, AND ASCOMYCETES (4) Morphology, taxonomy, phylogeny, and life histories; identification and field work. Prerequisite: Bot. 419. *Mr. Fergus*
523. BASIDIOMYCETES AND FUNGI IMPERFECTI (4) Morphology, taxonomy, phylogeny, and life histories. Prerequisite: Bot. 419. *Mr. Fergus*
524. (Zool. 524). SEMINAR IN GENETICS (1 per semester) *Mr. Wright*
- 525a, 525b. STRUCTURE OF ECONOMIC PLANTS (3-6) Developmental and reproductive features of (a) field and vegetable crops, (b) fruit crops. Bot. 525a is offered in the spring semester of odd years, 525b in the spring semester of even years. *Mr. Grove*
526. PHOTOMICROGRAPHY OF PLANT TISSUES (2) Prerequisite: Bot. 421 or Zool. 31 or For. 37. *Mr. Kribs*
- 527aS-527bS. PLANT BIOLOGY (3 each) (a) Structure and physiology; (b) reproduction processes, development and relationships of plant groups. Methods of obtaining materials and setting up experiments. Given in alternate years. Prerequisite: general biology or general botany courses.
528. (Zool. 528). POPULATION GENETICS (3) Factors affecting gene frequency, genotype frequency, genotype-environmental interaction, and genetic relationship in natural and artificial populations. *Mr. Mitchell*
529. DISEASES OF FORAGE CROPS (3) Etiology, symptomatology, and epidemiology of the more important diseases of forage grasses and legumes; critical evaluation of techniques of control. *Mr. Couch*
530. PLANT DISEASE CONTROL (3) Methods, and laboratory and field testing of materials used in plant disease control. *Mr. Fink*
531. PLANT PATHOLOGY SEMINAR (1 per semester) Selected topics of current research, history, and contemporary trends in plant pathology.
- 537S. (Ed. 537S, Zool. 537S). WORKSHOP IN THE BIOLOGICAL SCIENCES (3) Projects designed for teachers of biology in the secondary schools.

BUSINESS ADMINISTRATION †

Consult PROFESSOR G. K. NELSON

The Master of Science and Doctor of Philosophy degrees are offered with a major in Business Administration. Courses are provided in accounting, business statistics, and commerce.

BUSINESS ADMINISTRATION

ACCOUNTING

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| 400. CONTROLLERSHIP (3) | <i>Mr. Nelson</i> |
| 401. ADVANCED ACCOUNTING (3) | <i>Mr. Woolsey</i> |
| 403. ADVANCED AUDITING (3-9) | <i>Mr. Rowland</i> |
| 404. BUDGETARY CONTROL (3) | <i>Mr. Nelson</i> |
| 405. ADVANCED COST ACCOUNTING (3) | <i>Mr. Nelson</i> |
| 406. ADVANCED FEDERAL TAX ACCOUNTING (3) | <i>Mr. Rowland</i> |
| 407. C.P.A. REVIEW (3) | <i>Mr. Rowland</i> |
| 408. GOVERNMENTAL ACCOUNTING (3) | <i>Mr. Rowland</i> |
| | |
| 500. ACCOUNTING SEMINAR (3) Prerequisite: Acctg. 6. | <i>Mr. Rowland</i> |
| | |
| 501. ACCOUNTING SYSTEMS (3) Principles of system design including practical application to special businesses, such as financial institutions, department stores, public utilities, etc. Prerequisite: Acctg. 401. | <i>Mr. Rowland</i> |
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| 520. PROBLEMS IN ACCOUNTING (3-6) Planned individual projects involving library, laboratory, or field work. | <i>Mr. Woolsey</i> |

BUSINESS STATISTICS

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| 500. SEMINAR IN BUSINESS STATISTICS (3) | <i>Mr. Saylor</i> |
| 501. ADVANCED BUSINESS STATISTICS (3) | <i>Mr. Saylor</i> |

COMMERCE

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| 401. INDUSTRIAL PURCHASING (3) | <i>Mr. Babione</i> |
| 405. ANALYSIS OF FINANCIAL STATEMENTS (3) | <i>Mr. Bradley</i> |
| 406. INVESTMENT ANALYSIS (3) | <i>Mr. Malott</i> |
| 407. INVESTMENT BANKING (3) | <i>Mr. Bradley</i> |
| 410. BANK MANAGEMENT (3) | <i>Mr. McKinley</i> |
| 415. REGULATION OF TRANSPORT CARRIERS (3) | <i>Mr. Waters</i> |
| 417. FOREIGN MARKETS (3) | <i>Mr. Mares</i> |
| 422. SALES PROMOTION (3) | <i>Mr. Decker</i> |
| 424. MARKETING RESEARCH (3) | <i>Mr. Babione</i> |
| 425. INSURANCE AGENCY MANAGEMENT (3) | <i>Mr. Wherry</i> |
| 426. STORE MANAGEMENT AND OPERATION (3) | <i>Mr. Einstein</i> |
| 427. RETAIL BUYING AND MERCHANDISING (3) | <i>Mr. Einstein</i> |
| 428. RETAIL ADVERTISING AND SALES PROMOTION (3) | <i>Mr. Einstein</i> |
| 430. ADVANCED BUSINESS LAW (3) | <i>Mr. Phalan</i> |
| 436. FUNDAMENTALS OF SALES MANAGEMENT (3) | <i>Mr. Decker</i> |
| 455. CASES IN PUBLIC RELATIONS (3) | |
| 461. CASE STUDIES IN AMERICAN INDUSTRIES (3) | <i>Mr. Mares</i> |
| 477. ADMINISTRATIVE MANAGEMENT (3) | |
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| 500. CASE STUDIES IN BUSINESS ADMINISTRATION (3) Case studies of business and management policy with respect to procurement, production, selling, finance, accounting, relations with government, labor, and the public. | <i>Mr. Strong</i> |

BUSINESS ADMINISTRATION

501. COMMERCE SEMINAR (3-6) Reports on research in selected fields of commercial activities.
502. SEMINAR IN BUSINESS MANAGEMENT (3) *Mr. Strong*
503. TRANSPORTATION AND PUBLIC UTILITY SEMINAR (3) *Mr. Waters*
504. PROBLEMS IN COMMERCE (3-6) Planned individual projects involving library, laboratory, or field work. *Mr. Leffler*
506. SEMINAR IN INVESTMENTS AND CORPORATION FINANCE (3)
515. TRANSPORTATION RATES AND BUSINESS (3) Rate making and rate changes and their effects on business location and development. Prerequisite: Com. 15. *Mr. Waters*
517. INTERNATIONAL BUSINESS PRACTICES (3) Practices of exporters and importers dealing in commodities traded in world markets under competition, monopoly, or governmental control. Prerequisite: Com. 17. *Mr. Hench*
523. SEMINAR IN MARKETING (3-6) Research in modern marketing trends. *Mr. Babione*
525. CASE STUDIES IN INSURANCE (3) Analysis of management's insurance problems, such as the feasibility of self-insurance; proper allocation of insurance premiums and coverage in selected industries, etc. Prerequisites: Com. 25, 33. *Mr. Wherry*
526. ADVERTISING SEMINAR (3) Advertising budgeting, selection of media, appraisal of effectiveness, co-ordination of advertising and selling efforts. Prerequisite: Com. 23.
529. SEMINAR IN RETAILING (3) *Mr. Einstein*
536. SALES MANAGEMENT SEMINAR (3) Principles of sales planning and administration; co-ordination of selling with advertising, promotion, production, and accounting; use of market research selling costs and budgets.

CERAMIC TECHNOLOGY †

PROFESSOR G. W. BRINDLEY, *Head of the Department*

400. SPECIAL TOPICS (1-2)
401. CERAMIC BODIES AND GLAZES (3) *Mr. Hummel*
402. PRINCIPLES OF CERAMIC ENGINEERING (3)
403. CERAMIC ENGINEERING PROCESSES AND EQUIPMENT (3)
404. CERAMIC SEMINAR (1)
405. CERAMIC RESEARCH AND DESIGN (3)
411. THEORY OF CERAMIC PROCESSES (2) *Mr. Hummel*
- 413, 413X. CERAMIC PETROGRAPHY (3)
415. GLASS AND ENAMELS (3) *Mr. Ehman*
416. ADVANCED GLASS TECHNOLOGY (3) *Messrs. Weyl and Rindone*
420. REFRACTORIES (3)

CERAMIC TECHNOLOGY

500. SEMINAR IN CERAMIC TECHNOLOGY (1-2 per semester) Current developments in ceramic technology and related fields. Required of all graduate students in ceramic technology. *Mr. Brindley and Staff*
501. COLLOIDAL BEHAVIOR OF CLAYS AND MUDS (2-4) Colloidal properties of ceramic clays, glazes, drilling muds, filtering and bleaching clays, and kindred systems.
503. USE OF PHASE EQUILIBRIA DATA IN CERAMIC TECHNOLOGY (2-5) Phase equilibria in unary, binary, ternary, and other systems; applications in product development and in understanding behavior of ceramic materials. *Mr. Hummel*
506. MECHANICAL PROPERTIES OF CERAMIC MATERIALS (2-3) Experimental stress-strain-time relations in elasticity, anelasticity, plasticity, and rupture; theory of strength and control. *Mr. Buessem*
507. THERMAL PROPERTIES OF CERAMIC MATERIALS (2-3) Heat capacity, heat of fusion, thermal conductivity, and thermal expansion in relation to macroscopic measurements and basic atomic concepts applied to ceramic materials. *Mr. McQuarrie*
508. DIELECTRIC AND MAGNETIC PROPERTIES OF CERAMIC MATERIALS (2-3) Preparation and properties of ceramic semi-conductors, dielectrics, and magnetic materials. *Mr. Buessem*
510. SEMINAR IN GLASS TECHNOLOGY (1-2 per semester) Current developments in glass technology and related fields. *Mr. Weyl and Staff*
511. CHEMICAL ASPECTS OF THE CONSTITUTION OF GLASS (1-3 per semester) Historical development, properties, and atomistic interpretation for changes of properties with compositions, temperature, and past history. *Mr. Weyl*
512. PHYSICAL ASPECTS OF THE CONSTITUTION OF GLASS (1-3) Atomic structure of glass, its relation to physical properties; rheology; glass as a liquid. *Mr. Brindley*
515. SPECIAL PROBLEMS IN CERAMIC TECHNOLOGY (1-6 per semester) Advanced individual study on a problem in ceramics.
516. SELECTED TOPICS IN CERAMIC TECHNOLOGY (1-3 per semester) Intensive group study of special topics.
517. RESEARCH INSTRUMENTS AND EQUIPMENT (2) Applications of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations).
530. (Min. 530). STRUCTURE, PROPERTIES, AND OCCURRENCE OF CLAY MINERALS (2-5) Structure analysis and identification of clay minerals; mineral transformation and behavior; occurrence, genesis, and petrography of fine-grained sediments. *Messrs. Brindley, Bates, and Griffiths*

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in ceramic technology studies are listed under Mineral Sciences in Part II of this bulletin.

CHEMICAL ENGINEERING †

PROFESSOR DONALD S. CRYDER, *Head of the Department*

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| 402. CHEMICAL ENGINEERING (4) | <i>Mr. Carnahan</i> |
| 403. CHEMICAL ENGINEERING (4) | <i>Mr. Carnahan</i> |
| 404. CHEMICAL PLANT DESIGN (3) | |
| 405. THERMODYNAMICS FOR CHEMICAL ENGINEERS (3) | |
| 422. MOTOR FUELS (2) | <i>Mr. Carnahan</i> |
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| 500. SEMINAR IN CHEMICAL ENGINEERING (1) | Required of all graduate students. |
| 510. ADVANCED HEAT TRANSFER I (3) | Physical and chemical factors controlling the rate of heat transfer under conditions of steady flow. |
| | <i>Mr. Cryder</i> |
| 511. ADVANCED HEAT TRANSFER II (3) | Flow of heat under varying temperature conditions. |
| | <i>Mr. Cryder</i> |
| 515. DISTILLATION (3) | Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns. |
| | <i>Mr. Carnahan</i> |
| 516. ECONOMIC BALANCE (3) | Problem work on the design of chemical engineering equipment from the economic standpoint. |
| | <i>Mr. Cannon</i> |
| 518. CHEMICAL ENGINEERING DESIGN (3) | Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. |
| | <i>Mr. Cryder</i> |
| 524. CHEMICAL ENGINEERING, APPLICATION OF THERMODYNAMICS (3) | Elements of thermochemistry and thermodynamics of greatest importance in chemical engineering. |
| | <i>Mr. Cannon</i> |

CHEMISTRY †

PROFESSOR W. CONARD FERNELIUS, *Head of the Department*

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| 400. CHEMICAL LITERATURE (1) | <i>Mrs. Strauss</i> |
| 401. SEMINAR (1) | |
| 405. NUCLEAR AND RADIOCHEMISTRY (3) | Breakage ticket \$5. |
| 410. ADVANCED INORGANIC CHEMISTRY (4) | Breakage ticket \$5. |
| 411-412. FLUORINE CHEMISTRY (3 each) | |
| 413. INORGANIC PREPARATIONS AND LABORATORY METHODS (2-5) | Breakage ticket \$5. |
| | <i>Mr. Block</i> |
| 420. ADVANCED ANALYTICAL CHEMISTRY (4) | Breakage ticket \$10. |
| | <i>Messrs. Hayes, Jordan, and Schempf</i> |
| 426. INSTRUMENTAL METHODS OF ANALYSIS (3-5) | Breakage ticket \$10. |
| | <i>Messrs. Hayes, Jordan, and Schempf</i> |
| 434. QUANTITATIVE ORGANIC ANALYSIS (3-5) | Breakage ticket \$10. |
| 435. ORGANIC PREPARATIONS AND LABORATORY METHODS (3-5) | Breakage ticket \$10. |
| | <i>Mr. Oakwood</i> |
| 436. ORGANIC CHEMISTRY OF NATURAL PRODUCTS (3) | <i>Mr. Aston</i> |
| 437. QUALITATIVE ORGANIC ANALYSIS (3) | Breakage ticket \$5. |
| | <i>Messrs. Olewine and Noll</i> |

CHEMISTRY

- 440-441. ADVANCED PHYSICAL CHEMISTRY (3 each) *Messrs. Hutchison and Seward*
 448. COLLOID CHEMISTRY (3) Breakage ticket \$5. *Mr. Hutchison*
 ‡460-461. INTRODUCTORY PHYSICAL CHEMISTRY (3 each)
 ‡462. EXPERIMENTAL PHYSICAL CHEMISTRY (1) Breakage ticket \$5.
 ‡463. EXPERIMENTAL PHYSICAL CHEMISTRY (1) Breakage ticket \$5.
 ‡464. PHYSICAL CHEMISTRY (3)
 ‡465. PHYSICAL CHEMISTRY (2)
 470. CHEMICAL MICROSCOPY (3) Breakage ticket \$5. *Miss Willard*
 471. ADVANCED CHEMICAL MICROSCOPY (3) Breakage ticket \$5. *Miss Willard*
 472. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$5. *Mr. Fleming*
 473. TEXTILE MICROSCOPY (3) Breakage ticket \$5. *Miss Willard*
 474. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$5. *Mr. Fleming*
 476. MICROSCOPIC MICROTECHNIQUE (3) Breakage ticket \$5. *Miss Willard*
 477. CHEMICAL PHOTOMICROGRAPHY (3) Breakage ticket \$5. *Miss Willard*
 489. INTRODUCTION TO CHEMICAL RESEARCH (3-5) Breakage ticket \$10.
 489X. INTRODUCTION TO CHEMICAL RESEARCH (2)
 §490. ORGANIC CHEMISTRY (5) Breakage ticket \$5. *Mr. Olewine*
 §491. ORGANIC CHEMISTRY (5) Breakage ticket \$10. *Mr. Olewine*
 §492a. ADVANCED GENERAL CHEMISTRY (3)
 ¶493S. SELECTED TOPICS IN CHEMISTRY (3)
 ¶494S. CHEMICAL DEMONSTRATIONS (3)
500. SEMINAR IN INORGANIC CHEMISTRY (1)
 501. SEMINAR IN PHYSICAL CHEMISTRY (1)
 502. SEMINAR IN ORGANIC CHEMISTRY (1)
 503. SEMINAR IN ANALYTICAL CHEMISTRY (1)
516. SYSTEMATIC INORGANIC CHEMISTRY (3) Systematic treatment of inorganic chemistry in terms of modern concepts. *Messrs. Fernelius, Wartik, and Haas*
 517. CHEMISTRY OF THE LESS FAMILIAR ELEMENTS (3) Continuation of Chem. 516. *Messrs. Fernelius, Wartik, and Block*
 518. SPECIAL TOPICS IN INORGANIC CHEMISTRY (3 per semester) Modern developments in specialized fields.
 525. ANALYTICAL PROCESSES (3) Separative and determinative processes in analytical chemistry. *Messrs. Hayes, Jordan, and Schempf*
 526. MODERN INSTRUMENTAL ANALYSIS (3) *Messrs. Hayes, Jordan, and Schempf*
 527. SPECIAL TOPICS IN ANALYTICAL CHEMISTRY (2-12) *Messrs. Hayes, Jordan, and Schempf*
 531. SPECIAL TOPICS IN ORGANIC CHEMISTRY (3) May be taken for credit for four successive semesters.
 532. ORGANIC NITROGEN COMPOUNDS (3) Chemistry, stereochemistry, and molecular structure of organic compounds containing nitrogen. *Mr. Aston*

‡ Graduate credit not allowed for students majoring in chemistry or chemical engineering.

§ Candidates for the M.Ed. degree.

¶ Graduate credit only for degrees in education.

534. THEORETICAL ORGANIC CHEMISTRY (3) Modern theories of structure; resonance; interpretation of physical properties; theory of rates; equilibrium properties. *Mr. Aston*
- 535-536. ORGANIC CHEMISTRY (3 each) Adapted to the needs of those doing research work in organic chemistry. *Mr. Zook*
538. ORGANIC CHEMISTRY (3) Survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry. *Messrs. Noll and Oakwood*
539. STEREOCHEMISTRY (3) Comprehensive treatment of the principles of stereochemistry as applied to organic compounds. *Mr. Oakwood*
541. PHASE RULE (3) The phase rule and its applications.
542. COLLOIDS (3) The physics and chemistry of surfaces and their resulting colloid properties. Methods of preparing colloids. *Mr. Smith*
543. RHEOLOGY OF COLLOIDS (3) Continuation of Chem. 542. Rheology especially as applied to colloids and similar substances. *Mr. Smith*
544. CHEMICAL THERMODYNAMICS (3) Development of thermodynamic theory with special reference to common physical changes and chemical reactions. Prerequisite: Chem. 441 or 562. *Messrs. Aston and Fritz*
545. CHEMICAL THERMODYNAMICS AND INTRODUCTORY STATISTICAL MECHANICS (3) Continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544. *Messrs. Aston and Fritz*
546. QUANTUM CHEMISTRY (3) Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with special emphasis on the portion of the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Given alternate years only. *Mr. Aston*
547. STATISTICAL MECHANICS (3) Properties of matter at equilibrium, developed on the basis of energy levels of molecules and statistical mechanical theory. Prerequisite: Chem. 546. Given alternate years only. *Mr. Aston*
548. CATALYSIS (3) Theory of catalysis and its application to industry.
- 561-562. CHEMICAL PRINCIPLES (3 each) Mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 461, Math. 43, Phys. 285. A course in organic chemistry is recommended. *Messrs. Seward, Fritz, Ascah, and Taft*
563. CHEMICAL KINETICS (3) Theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions. *Messrs. Ascah and Taft*
564. CHEMICAL KINETICS (3) Continuation of Chem. 563 but including theory and measurement of photochemical reactions. *Messrs. Ascah and Taft*
- 565-566. ATOMIC AND MOLECULAR STRUCTURE (3 each) Structure of chemical species and correlation of experimentally determined properties by structural theory.
- 567-568. ADVANCED THEORETICAL CHEMISTRY (3 each) Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory.

CHILD DEVELOPMENT† AND FAMILY RELATIONSHIPS†

PROFESSOR WINONA L. MORGAN, *Head of the Department*

The master's degree is offered in the general field of Child Development and Family Relationships, and courses are listed under that general designation. The doctorate is offered both in Child Development and in Family Relationships.

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| 405. MARRIAGE AND FAMILY RELATIONSHIPS (3) | <i>Mr. Smith</i> |
| 429, 429X. CHILD DEVELOPMENT (3) | <i>Miss Avery</i> |
| 430. OBSERVATION AND EXPERIENCE IN NURSERY SCHOOL (1-4) | |
| 440, 440X. STUDY OF LATER CHILDHOOD (3) | <i>Miss Avery</i> |
| 441. NURSERY SCHOOL ORGANIZATION (3) | <i>Miss Morgan</i> |
| 445. (Psy. 445). DEVELOPMENT THROUGHOUT ADULthood (3) | <i>Mr. Britton</i> |
| 481. EDUCATIONAL METHODS WITH PRESCHOOL CHILDREN (3) | <i>Miss Bovie</i> |
| 482. EDUCATIONAL PROCEDURES IN CHILD DEVELOPMENT AND FAMILY RELATIONS (3) | <i>Miss Morgan</i> |
| 495S. (Ed. 495S, Hl.Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9) | |
508. PARENTAL EDUCATION (3) Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: Ch.Fm. 429, 430. *Miss Morgan*
- 515, 515X. THE TEACHING OF CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (3) Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for Ch.Fm. 482. Prerequisite: 6 credits in child development and family relationships. *Miss Morgan*
529. (Psy. 529). SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisites: 6 credits in child development or 6 in educational or child psychology, plus 3 in statistics. *Miss Morgan*
530. PROBLEMS IN CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (1-6) Problems involving individual research in library, laboratory, or field projects.
536. CHILDREN IN POSTWAR FAMILIES AND COMMUNITIES (3) Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: Ch.Fm. 429, 430, or 2 courses in psychology. *Miss Morgan*
- 545, 545X. THE FAMILY IN ITS COMMUNITY (2-3) Cultural influences on family relationships; how the family orients its members to community living and group participation. Prerequisites: Soc. 1, Ch.Fm. 405; R.Soc. 452 or Psy. 419. *Mr. Smith*
546. SEMINAR IN FAMILY RELATIONSHIPS (1-3) Reading, reports, and discussion of recent research in relationship aspects of family living; particular attention to studies of roles, crises, and adjustments within the family setting. Prerequisite: Ch.Fm. 405 or 6 credits in sociology or psychology. *Mr. Smith*

CIVIL ENGINEERING †

PROFESSOR BENJAMIN A. WHISLER, *Head of the Department*

The Master of Science degree is offered in both Civil Engineering and Sanitary Engineering, but the Doctor of Philosophy degree is offered in Civil Engineering only. The following courses apply to both majors.

- 400. SEMINAR (1-3)
- 401. CIVIL ENGINEERING PROJECTS (2-12)
- 412. ADVANCED PHOTOGRAMMETRY (3)
- 421. HIGHWAYS AND STREETS (3)
- 422. RAILROADS (3)
- 423. HIGHWAY SAFETY AND TRAFFIC CONTROL (3)
- 431. CIVIL ENGINEERING CONSTRUCTION (3)
- 441. STATICALLY INDETERMINATE STRUCTURES (3)
- 442, 442X. STATICALLY INDETERMINATE STRUCTURES (3)
- 443. PHOTOELASTICITY AND MODEL ANALYSIS (3)
- 444, 444X. SOIL MECHANICS AND FOUNDATIONS (3)
- 446. ADVANCED SOIL MECHANICS (3)
- 451. ADVANCED HYDROLOGY (3)
- 462. ADVANCED HYDRAULICS (3)
- 465. APPLIED HYDRAULICS (3)
- 466. HYDRAULIC MACHINERY (3)
- 471. MUNICIPAL AND RURAL SANITATION (3)
- 472. TREATMENT PLANTS (4)
- 473. WATER AND SEWAGE ANALYSIS (3)
- 474. SANITARY ENGINEERING PROBLEMS (1-6)
- 481. MUNICIPAL PLANNING AND ZONING (3)

- 500. SEMINAR IN CIVIL ENGINEERING (1-6) Reports on researches and special topics.
Course may be continued in subsequent semesters.

- 521. TRANSPORT PLANNING AND DESIGN (2-6) Planning and design of transportation facilities; basic principles and engineering techniques applied to airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.
- 522. TRANSPORT OPERATION AND MAINTENANCE (2-6) Engineering problems in operation, maintenance, and administration of airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

- 540. ADVANCED STRUCTURAL ANALYSIS (2-4) Geometry of flexure, deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C.E. 40.
- 541. ADVANCED STRUCTURAL ANALYSIS (2-4) Truss deflection; trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C.E. 40.
- 542. APPLIED SOIL MECHANICS (2-5) Soil classification by type of clay minerals and profile development; aerial photographic interpretation of soils and applications to site selection for dams, highways, and airports. Prerequisites: C.E. 412, 444. Geol. 71.

543. STRUCTURAL ENGINEERING PROJECTS (3-10) Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C.E. 441, 442.
544. ADVANCED STRUCTURAL DESIGN (2-4) Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisites: C.E. 42, 442.
545. ADVANCED STRUCTURAL DESIGN (2-4) Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C.E. 41.
550. ENGINEERING CONSTRUCTION (2-4) Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C.E. 41, 42.
551. HYDROLOGIC INVESTIGATIONS (2-8) Application of hydrologic principles and techniques to a specific project. Prerequisite: C.E. 451.
560. THEORY OF HYDRAULIC MODELS (3) Application of dimensional analysis and similitude to models used in the study of problems in hydraulics.
565. TRANSPORTATION OF SOLIDS BY FLUIDS (2-5) Fundamentals of the flow of solids in open and closed conduits; e.g., suspended load and bed load in rivers, slurries and pulp stocks in pipes.
566. FLUID MECHANICS OF HYDRAULIC MACHINERY (3) Advanced theory and design of hydraulic machinery. Prerequisite: C.E. 466.
568. THEORETICAL HYDRODYNAMICS (3-6) Fundamental equations of fluid motion, stream function, velocity potential, flow nets, transformations, motion of viscous fluids, applications.
570. RURAL SANITATION DESIGN (3) Requirements and devices essential to rural sanitary problems: water supply, excreta disposal, industrial waste treatment. Not intended for civil or sanitary engineering students. Prerequisites: Chem. 4, Phys. 285.
571. WATER PURIFICATION AND SOFTENING (3) Current methods of softening, disinfecting, and conditioning water for municipal and industrial use. Prerequisite: C.E. 70.
572. SEWAGE TREATMENT (3) Modern methods of sewage treatment. Prerequisite: C.E. 70.
573. ADVANCED PROBLEMS IN SANITARY ENGINEERING (3-10) Continuation of C.E. 474 on a graduate level. Prerequisite: C.E. 474.
575. ADVANCED INDUSTRIAL WASTE TREATMENT (3) Techniques of industrial waste treatment; attendant stream pollution and stream self-purification factors. Prerequisite: C.E. 472 or 572.
576. WATER TREATMENT PLANT DESIGN (1-6) Design of works for treatment of water for municipal and industrial use. Prerequisite: C.E. 71.
577. SEWAGE TREATMENT PLANT DESIGN (1-6) Design of works for treatment of sewage or industrial wastes. Prerequisite: C.E. 71.

578. INDUSTRIAL HYGIENE (3) Principles of control of industrial toxics and the protection of the worker and the community.
579. PUBLIC HEALTH ADMINISTRATION (3) Operation and duties of health departments at the various levels.

CLINICAL SPEECH †

Consult PROFESSOR EUGENE T. McDONALD

The master's degree and the doctorate are offered with a major in Clinical Speech, but courses are designated as Speech Education.

SPEECH EDUCATION

430. HEARING PROBLEMS AND THE TESTING OF HEARING (3)
434. AUDIOMETRY AND HEARING AIDS (3)
435. CLINICAL PRACTICE WITH THE HEARING HANDICAPPED (1-6)
Unit A. Audiologic Evaluation and the Selection of Hearing Aids (1-4)
Unit B. Auditory Training and Speech Reading (1-4)
436. INTRODUCTION TO SPEECH CORRECTION (3)
437. CLINICAL PRACTICE IN SPEECH CORRECTION (1-3)
- 439X. FUNDAMENTALS OF SPEECH EDUCATION (3)
- 439aX. METHODS IN SPEECH EDUCATION (3)
- 440, 440X. SPEECH EDUCATION FOR THE CLASSROOM TEACHER (2-3)
- 441S. CURRENT PROBLEMS IN SPEECH AND HEARING (1-6)
442. SPEECH PATHOLOGY (3)
443. METHODS IN AUDITORY TRAINING AND SPEECH READING (3)
445. THE PUBLIC SCHOOL SPEECH CORRECTION PROGRAM (3)
525. SEMINAR IN CLINICAL SPEECH PATHOLOGY (3-9) Prerequisites: Sph.Ed. 436, 442.
Unit A. Cleft Palate
Unit B. Cerebral Palsy
Unit C. Aphasia
530. SEMINAR IN AUDIOLOGY (2-4) Review of theories of hearing, and review of related physiological and psychological researches. Prerequisite: Sph.Ed. 434.
537. ADVANCED CLINICAL PRACTICE IN SPEECH CORRECTION (1-9) Prerequisites: Sph. Ed. 437, 442.
Unit A. Diagnostic Procedures (1-3)
Unit B. Treatment Procedures (1-6)
540. ARTICULATION DISABILITIES (3) Speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisites: Sph. Ed. 437, 442.

CLINICAL SPEECH

541. THE VOICE AND ITS DISORDERS (3) Physical, physiological, and psychological bases of voice production; causes, nature, and symptoms of its disorders; current clinical methods in voice improvement. Prerequisites: Sph.Ed. 437, 442.
542. STUTTERING AND ALLIED DISORDERS (3) Modern theories of causes of disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisites: Sph. Ed. 437, 442.
543. DIAGNOSTIC PROCEDURES IN CLINICAL SPEECH (3) Clinical instrumentation; case history taking; examination procedures and materials used in diagnosing speech disabilities; interpretation of findings; report preparation. Prerequisites: Sph.Ed. 437, 442.

CLOTHING AND TEXTILES †

PROFESSOR RUTH W. AYRES, *Head of the Department*

- 402, 402X. FUNDAMENTAL PRINCIPLES OF TAILORING CONSTRUCTION (3)
403. CREATIVE PATTERN MAKING (3)
404. DRAPING (3)
- 405, 405X. FASHION MERCHANDISING (3)
406. FASHION PROMOTION (3)
407. THE TEXTILE AND CLOTHING INDUSTRY (3)
408. INTERMEDIATE TEXTILES (3)
410. CLOTHING FOR THE FAMILY (3)
411. ADVANCED CLOTHING CONSTRUCTION (3)
503. ADVANCED PATTERN DEVELOPMENT (3) Analysis of advanced pattern designing principles to give students facility in original designing.
504. ADVANCED DRAPING (3) Analysis of principles and techniques as a basis for creation of original designs; survey of literature in dress design.
- 505, 505X. CLOTHING INSTRUCTIONAL MATERIALS (3) Development of instructional materials and techniques based on needs of diverse groups.
506. THE FASHION WORLD (3)
507. PROBLEMS IN RELATION TO CLOTHING CONSUMPTION (3) Problems connected with manufacture and consumption of clothing; interrelation of textile and clothing trades with other industries.
508. SPECIAL PROBLEMS IN CLOTHING AND TEXTILES (1-6) Individual directed study, investigation, and practice in selected phases of textiles and clothing.
- 509, 509X. SEMINAR IN CLOTHING AND TEXTILES (1-6)
510. RESEARCH METHODS AND EVALUATION IN CLOTHING AND TEXTILES (1-6)
511. CURRENT DEVELOPMENTS IN CLOTHING AND TEXTILES (1-6)
512. HISTORY OF CLOTHING AND CLOTHING CONSTRUCTION (3)

COMPARATIVE LITERATURE †

Consult PROFESSOR PHILIP A. SHELLEY

The master's degree and the doctorate are offered in the field of Comparative Literature. Candidates select courses from the classical and modern languages and literature as well as from comparative literature.

400. COMPARATIVE METHOD IN LITERARY STUDIES (3)
 443. (Ger. 443). LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9) *Mr. Shelley*
 480. INTRODUCTION TO FOLKLORE (3) *Mr. Bayard*
 500. SEMINAR IN COMPARATIVE LITERATURE (3-6)

DAIRY SCIENCE †

PROFESSOR DONALD V. JOSEPHSON, *Head of the Department*

418. DAIRY SURVEY (1) *Mr. Josephson*
 421. DAIRY MANUFACTURING PROBLEMS (1-6) *Mr. Doan and Staff*
 427. MILK SECRETION (3) *Mr. Kesler*
 428. DAIRY PRODUCTION PROBLEMS (1-3) *Messrs. Kesler and Williams*
 430. TECHNICAL CONTROL OF DAIRY PRODUCTS (4) *Mr. Watrous*
 431. PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (3) *Mr. Almquist*
 501. BUTTER AND CHEESE (1-6) Manufacture and handling of butter and cheese. Prerequisites: D.Sc. 10, 23, Bact. 8, A.B.Ch. 403.
 502. CONDENSED MILK AND MILK POWDER (1-6) Condensing and drying of milk. Prerequisites: D.Sc. 10, 26, Bact. 8, A.B.Ch. 403. *Mr. Doan*
 503. PUBLIC MILK PROBLEMS (1-6) Handling milk in modern plants. Prerequisites: D.Sc. 11, Bact. 8, A.B.Ch. 403. *Mr. Doan*
 504. ICE CREAM MANUFACTURE (1-6) Manufacture of ice cream, ices, and other frozen milk products. Prerequisites: D.Sc. 11, Bact. 8, A.B.Ch. 403.
 505. DAIRY PLANT ECONOMICS (1-6) Economic factors involved in creamery operation and management. Prerequisites: D.Sc. 7, 11.
 507. DAIRY CATTLE MANAGEMENT (1-6) Management of dairy cattle. Prerequisite: D.Sc. 27. *Mr. Williams and Staff*
 508. DAIRY SEMINAR (1-6) Preparation and presentation of a paper on an assigned subject. *Mr. Josephson and Staff*
 509. TESTING DAIRY PRODUCTS (1-6) Constituents of dairy products. Prerequisites: D.Sc. 11, Bact. 8, A.B.Ch. 403. *Mr. Doan*
 510. DAIRY CATTLE FEEDING (1-6) Application of fundamental research in animal nutrition to the feeding of dairy cattle. Prerequisites: D.Sc. 1, 29. *Mr. Williams*

DAIRY SCIENCE

511. DAIRY CATTLE NUTRITION (1-6) Nutritional requirements of dairy cattle. Prerequisites: A.Ntr. 401, 402. *Mr. Kesler*
512. ADVANCED STUDIES IN MILK SECRETION (1-6) Physiology of milk secretion. Prerequisite: D.Sc. 427.
513. DAIRY CATTLE SELECTION (1-6) Breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.Sc. 1, 30.
515. ADVANCED PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (1-6) Reproduction of farm animals. *Mr. Almquist*
516. ARTIFICIAL BREEDING OF FARM ANIMALS (1-6) Prerequisite: D.Sc. 431. *Mr. Almquist*
517. DAIRY SCIENCE LITERATURE (1-6) Review and reporting of dairy literature. *Mr. Josephson and Staff*
522. RESEARCH PROCEDURES IN DAIRY TECHNOLOGY (3) Research problems and methods in dairy technology with major emphasis on dairy chemistry. Prerequisite: A.B.Ch. 403. *Mr. Patton*

DRAMATICS *

PROFESSOR WALTER H. WALTERS

Head of the Department of Theatre Arts

403. ADVANCED MAKE-UP (1)
404. STYLES OF ACTING (3)
412. ADVANCED SCENE DESIGN (3)
413. ADVANCED STAGE LIGHTING (3)
421. ADVANCED PLAYWRITING (3)
431. HISTORY OF THE THEATRE (3)
- 442S. EDUCATIONAL DRAMATICS (3)
- 443S. EDUCATIONAL DRAMATICS (ADVANCED MARIONETTES) (3)
451. DIRECTING (3)
452. CENTRAL STAGING (3)
480. RADIO DRAMA (3)
481. ADVANCED RADIO DRAMA (3)
501. PROBLEMS OF DIRECTING (3-6) Seminar in problems of production with particular stress on direction. Students will direct plays under staff supervision.
502. SEMINAR IN THE TECHNICAL PROBLEMS OF DRAMATIC PRODUCTION (3-6) Prerequisite: Dram. 11.
504. SEMINAR IN STYLES OF ACTING (3-6) Practical work required of each student.
506. EVALUATION AND APPRECIATION OF MODERN DRAMATIC ENTERTAINMENT (3) Prerequisites: Dram. 1, 61.
507. SEMINAR IN FUNDAMENTAL THEORIES OF THEATRE AND DRAMA (3-6)
521. PLAYWRITING (3-6) Prerequisites: Dram. 21, 421.

ECONOMICS †

PROFESSOR HOWARD A. CUTLER, *Head of the Department*

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| 400. HISTORY OF ECONOMIC THOUGHT (3) | <i>Mr. Liebhafsky</i> |
| 401. RECENT ECONOMIC THOUGHT (3) | <i>Mr. Liebhafsky</i> |
| 405. INTERMEDIATE ECONOMIC THEORY (3) | <i>Mr. Fouraker</i> |
| 412. ECONOMICS OF COLLECTIVE BARGAINING (3) | <i>Mr. Myers</i> |
| 415. SOCIAL INSURANCE (3) | <i>Mr. Reede</i> |
| 418. ECONOMICS OF WAGES AND EMPLOYMENT (3) | <i>Mr. Liebhafsky</i> |
| 419. CASE STUDIES IN LABOR-MANAGEMENT RELATIONS (3) | <i>Mr. Reede</i> |
| 423. PENNSYLVANIA LOCAL AND STATE FINANCE (3) | <i>Mr. Stout</i> |
| 425. THE MONEY MARKET (3) | <i>Mr. McKinley</i> |
| 426. FISCAL POLICY (3) | |
| 427. MONETARY THEORY AND POLICY (3) | |
| 430. NATIONAL PLANNING (3) | |
| 431. HOUSING AND COMMUNITY DEVELOPMENT (3) | |
| 433. INTERNATIONAL MONETARY ECONOMICS (3) | <i>Mr. Reedy</i> |
| 434. INTERNATIONAL TRADE AND PUBLIC POLICY (3) | <i>Mr. Reedy</i> |
| 442. STRUCTURE OF THE ECONOMY AND PUBLIC POLICY (3) | <i>Mr. Herman</i> |
| 450. THE BUSINESS CYCLE (3) | |
| 480. MATHEMATICAL ECONOMICS (3) | <i>Mr. Mendelson</i> |
| 490. MEASUREMENT OF THE ECONOMY (3) | <i>Mr. Saylor</i> |
| 499X. FOREIGN STUDY IN ECONOMICS (2-6) | |
| 500. ECONOMICS SEMINAR (3-6) | |
| 501. RESEARCH METHODS IN ECONOMICS (3-6) | |
| 506. PROBLEMS IN ECONOMICS (3-6) Planned individual projects involving library, laboratory, or field work. | |
| 507. SEMINAR IN INTERNATIONAL ECONOMICS: THEORY AND POLICY (3-6) | |
| 508. SEMINAR IN MONEY, CREDIT, AND PUBLIC FINANCE (3-6) Prerequisite: Econ. 51. | |
| 510. DEMAND ANALYSIS (3) | <i>Mr. Mendelson</i> |
| 511. SEMINAR IN INDUSTRIAL DISPUTES (3) Prerequisites: Econ. 14, 15. | <i>Mr. Myers</i> |
| 512. WAGES (3) | |
| 515. LABOR SEMINAR (3) | <i>Mr. Reede</i> |
| 522. ADVANCED ECONOMIC THEORY (3-6) Theory of price and income determination. Prerequisite: Econ. 405. | <i>Mr. Mendelson</i> |

EDUCATION

PROFESSOR CHARLES M. LONG, *Head of the Department*

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| BUSINESS EDUCATION † | GUIDANCE † |
| EDUCATIONAL ADMINISTRATION † | HIGHER EDUCATION ‡ |
| ELEMENTARY EDUCATION † | SECONDARY EDUCATION † |

‡ The doctor's degree is conferred in this field but not the master's degree.

In addition to the master's and the doctor's degrees offered in the six fields listed above, attention is called to majors in Agricultural Education, Art Education, Health Education, Home Economics Education, Industrial Education, Music Education, Physical Education, and Recreation Education listed elsewhere.

412. HISTORY OF MODERN EUROPEAN EDUCATION (3)
 413, 413X. HISTORY OF EDUCATION IN THE UNITED STATES (2-3)
 415S, 415X. MODERN TENDENCIES IN AMERICAN EDUCATION (1-6)
 416X. SOCIAL EDUCATION (3)
 421X. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)
 424, 424X. VISUAL AND OTHER SENSORY AIDS FOR TEACHERS (1-3) *Mr. VanderMeer*
 425S, 425X. THE SCIENTIFIC DIRECTION OF LEARNING ACTIVITIES (2-4)
 426, 426X. EDUCATION OF EXCEPTIONAL CHILDREN (2-3) *Miss Neuber*
 427. EDUCATION OF THE MENTALLY RETARDED (2-3) *Miss Neuber*
 428, 428X. ADULT EDUCATION: ORGANIZATION, TYPES, AND METHODS (1-3) *Miss Cologne*
 Unit A. History, Philosophy, and General Organization and Administration of Adult Education (1)
 Unit B. Types of Adult Education: Parental Education (1)
 Unit C. Methods in Adult Education and Leadership of Discussion Groups (1)
 429, 429X. EDUCATION OF THE MENTALLY GIFTED CHILD (1-3) *Miss Neuber*
 430, 430X. VISUAL AND OTHER AIDS IN SAFETY EDUCATION (3)
 432b, 432bX. THE ELEMENTARY SCHOOL READING PROGRAM (2-3) *Messrs. Murphy and Hunt*
 432c, 432cX. READING PROBLEMS IN THE SECONDARY SCHOOL (2-3) *Messrs. Murphy and Hunt*
 432d, 432dX. SPECIAL PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL ENGLISH (2-3) *Mr. Murphy*
 432eX. CHORAL SPEAKING (3) *Mr. Murphy*
 432f, 432fX. TEACHING SECONDARY SCHOOL ENGLISH (2-3) *Mr. Murphy*
 432g, 432gX. READING DISABILITIES (2-3) *Mr. Hunt*
 432h, 432hX. TECHNIQUES IN REMEDIAL READING (2-6) *Mr. Hunt*
 433c. ADVANCED THEORY OF KINDERGARTEN (3) *Mrs. Graffius*
 433f, 433fX. TEACHING CHILDREN'S LITERATURE (2-3) *Mr. Murphy*
 433h, 433hX. PROBLEMS OF ELEMENTARY SCHOOL ARITHMETIC (2-3) *Mr. Corle*
 433n, 433nX. TEACHING SOCIAL STUDIES IN THE ELEMENTARY GRADES (2-3) *Miss Taylor*
 433w, 433wX. TEACHING SOCIAL STUDIES IN THE HIGH SCHOOL (2-3) *Mr. VanderMeer*
 433y, 433yX. TEACHING MATHEMATICS IN THE SECONDARY SCHOOL (3)
 435X. EDUCATION FOR CITIZENSHIP (2-3)
 438, 438X. TEACHING SCIENCE IN SECONDARY SCHOOLS (2-3) *Miss Alfke*
 438e, 438eX. TEACHING SCIENCE IN THE ELEMENTARY SCHOOL (1-3)
 439, 439X. TEACHING TRAFFIC SAFETY AND AUTOMOBILE OPERATION (3) *Messrs. Neyhart and Intorre*
 440, 440X. ORGANIZATION AND SUPERVISION IN SAFETY EDUCATION (3)
 441X. PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS (2-3)
 442, 442X. ELEMENTARY EDUCATION (2-3)
 445. PRODUCTION OF VISUAL AND AUDITORY MEDIA (2-9)
 Unit A. Preparation of Educational Still Pictures (2-3)
 Unit B. Scripting and Shooting Educational Motion Pictures (2-3)
 Unit C. Editing and Sound Recording in the Production of Educational Motion Pictures (2-3)
 446, 446X. DIAGNOSIS OF ATTAINMENT (3) *Mr. Cobb*
 448X. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3)

- 449aS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3) *Mr. Porter*
- 449bS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3) *Mr. Porter*
- 449cS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3) *Mr. Porter*
- 449dS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3) *Mr. Porter*
- 450X. SECONDARY EDUCATION (2-3) *Mr. Butler*
- 451X. SPECIAL PROBLEMS OF THE HIGH SCHOOL TEACHER (2-3)
- 453, 453X. GUIDANCE PRINCIPLES AND PRACTICES (3) *Mr. Wellington*
- 454, 454X. EXTRACURRICULAR ACTIVITIES IN THE JUNIOR AND SENIOR HIGH SCHOOL (2-3) *Messrs. Moyer and Patrick*
- 456, 456X. PRINCIPLES AND PROBLEMS IN BUSINESS EDUCATION (1-3) *Mr. Gemmel, Miss Veon*
- 459, 459X. IMPROVEMENT OF INSTRUCTION IN BUSINESS SKILL SUBJECTS (1-3) *Mr. Gemmell*
460. CURRICULUMS IN BUSINESS EDUCATION (3) *Mr. Gemmell*
461. IMPROVEMENT OF INSTRUCTION IN BASIC BUSINESS SUBJECTS (3) *Mr. Gemmell*
462. TEACHING OF SHORTHAND AND TYPEWRITING (3) *Mr. Gemmell*
463. TEACHING OF BOOKKEEPING (3) *Mr. Gemmell, Miss Veon*
464. METHODS OF TEACHING DISTRIBUTIVE EDUCATION (3)
466. TEACHING OF OFFICE PRACTICE (3) *Miss Veon*
467. TEACHING OF SHORTHAND (2-3) *Miss Veon*
468. TEACHING OF TYPEWRITING (2-3) *Miss Veon*
- 470, 470X. EDUCATIONAL MEASUREMENTS (2-3)
- 474, 474X. TEACHING AND GROUP GUIDANCE ABOUT OCCUPATIONS (3) *Mr. Corle*
- 480, 480X. EDUCATIONAL ADMINISTRATION (2-3) *Mr. DeLacy*
- 482X. SUPERVISION AND IMPROVEMENT OF INSTRUCTION (2-3)
- 485X. CURRICULUM CONSTRUCTION (2-3) *Messrs. McGarey and McNerney*
- 487, 487X. PROBLEMS IN VISUAL AND OTHER SENSORY AIDS IN EDUCATION (1-14) *Mr. VanderMeer*
- Unit A. Organization and Administration of Visual-Sensory Aids Programs (1-3)*
- Unit B. Motion Pictures in Education (2-3)*
- Unit C. Radio and Television in Education (3)*
- Unit D. Still Pictures (1-2)*
- ‡*Unit E. Advanced Audio-Visual Equipment (3)*
- 490X. PHILOSOPHY OF EDUCATION (3)
- 491X. SCHOOL LAW (3)
493. CHARACTER EDUCATION (2-3) *Mr. Chiappetta*
494. RELIGIOUS EDUCATION (2-3)
- 495S. (Ch.Fm. 495S, Hl.Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)
- 497S, 497X. WORKSHOP IN SELECTED STUDIES IN ELEMENTARY AND SECONDARY EDUCATION (1-6)
- 498, 498X. PRACTICUM IN THE EDUCATION OF ATYPICAL CHILDREN (1-8)
- 499, 499X. ATYPICAL CHILDREN AND EDUCATIONAL ADJUSTMENTS (3) *Miss Neuber*
501. INTRODUCTION TO THE ADVANCED STUDY OF EDUCATION (1-3) Methods of educational research; criticism of studies and theses in education; initiating research projects; summarizing results of research. Prerequisite: Ed. 470 or Psy. 415. *Mr. Davison*

‡ This unit is not approved for extension.

502. SUPERVISED EXPERIENCE IN STUDENT COUNSELING (3) Practice in the application of guidance principles and methods to cases counseled under supervision; case conferences; seminar in guidance techniques. Prerequisite: Ed. 453.
Mr. Wellington
503. SUPERVISION OF GUIDANCE WORKERS (3) Practical experience in supervising and evaluating work of counselors. Prerequisite: Ed. 502.
Mr. Wellington
504. ORGANIZATION AND ADMINISTRATION OF GUIDANCE PROGRAMS (3) Principles, organization, personnel, functions, integration with school program, evaluation. Prerequisite: Ed. 453.
Mr. Wellington
505. OCCUPATIONAL AND EDUCATIONAL INFORMATION (3) Occupational information for guidance purposes, educational information related to vocational choice and preparation. Prerequisite: Ed. 453.
Mr. Wellington
506. STUDENT ANALYSIS PROCEDURES FOR COUNSELORS (3) Collection and use of data basic to the counselor's understanding of individuals; the counseling interview and techniques other than testing.
Mr. Wellington
- 507, 507X. GUIDANCE SERVICES IN ELEMENTARY EDUCATION (3) Guidance services to elementary school students; guidance opportunities for elementary teachers and principals.
510. INTERNSHIP IN PROFESSIONAL EDUCATION (1-9) Internship to take place in schools or educational situations where not regularly employed under supervision of graduate faculty.
Unit A. Administration and Supervision (1-6)
Unit B. College Teaching (3-6)
Unit C. Public School Research (3-6)
Unit D. Elementary Teaching (3-6)
Unit E. Secondary Teaching (3-6)
Unit F. Art Teaching and Supervision (3-6)
Unit G. Business Education Supervision (3-6)
Unit H. Special Education Supervision (3-6)
Unit I. Audio-Visual Education (3-6)
515. COMPARATIVE EUROPEAN EDUCATION (3) Educational policies and practices in school systems in western and central European nations. Prerequisite: Psy. 14.
Messrs. Chiappetta and Russell
516. SOCIAL FOUNDATIONS OF EDUCATION (2-4) Social institutions and functions and their relationship to public education; an analysis of the functions assignable to formal education. Prerequisites: Ed. 25, Psy. 14.
Mr. McNerney
517. EVOLUTION OF EDUCATIONAL THOUGHT (2-3) Rise of formal educational philosophy from Plato to John Dewey; preliminary reference to Chinese, Hindu, Chaldean, Persian, Hebrew, and Egyptian theories.
523. LABORATORY IN ORGANIZATIONAL ASPECTS OF MATERIALS OF INSTRUCTION (1-3) Organizing, storing, circulating, and maintaining instructional material in an instructional materials library. Prerequisites: Ed. 424, 585. Conference 1 hour, alternate weeks by appointment.
Mr. VanderMeer
524. SEMINAR IN CURRICULUM MATERIALS AND THEIR UTILIZATION (3) Advanced detailed analysis of mass communication media; relationships among these and educational objectives, individual differences in learners, and ideas to be communicated. Prerequisites: Ed. 424, 585, 6 credits in educational psychology.
Mr. VanderMeer

525. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3) Study of science supporting dynamic instruction; principles of teaching as guides; analysis of modern procedures; understanding of learning; substance versus plans. Prerequisite: 12 credits of undergraduate work in education. *Messrs. Butler and Russell*
527. PROBLEMS IN THE EDUCATION OF THE MENTALLY RETARDED (1-4) Study of existing curriculums, instructional practices, educational programs; experimentation in curriculum building and materials construction. Prerequisites: Ed. 426 or 583, Unit P, and Ed. 427 and teaching experience. *Miss Neuber*
529. PROBLEMS IN THE EDUCATION OF THE MENTALLY GIFTED (1-4) Analysis of educational needs of mentally gifted; curriculum construction and curricular materials. Prerequisites: teaching experience and Ed. 426 or 583, Unit P, and 429. *Miss Neuber*
532. SUPERVISION OF STUDENT TEACHERS (3) A course in supervision for master teachers, department heads, and college teachers with supervisory responsibilities in teacher education. Prerequisite: teaching experience and 18 credits in education, including at least 5 in methods. *Mr. Moyer, Miss Taylor*
- 534a. READING CLINIC PRACTICE: ANALYSIS OF READING DISABILITIES (1-9) A laboratory course consisting of analysis of extreme reading disabilities and recommended remedial procedures; experience in preparation of case reports. Prerequisite: Ed. 432g or Psy. 550. *Mr. Hunt*
- 534b. READING CLINIC PRACTICE: REMEDIAL PROCEDURES (1-9) Practicum in special classes for reading disabilities; corrective and remedial procedures; specific procedures for correction of various types of reading disabilities. Prerequisite: Ed. 432g or 534a. *Mr. Hunt*
535. SEMINAR ON READING INSTRUCTION (2-12) Designed to appraise significant researches and to outline procedures and materials for research; reading readiness, word perception, basic reading skills, vocabulary development. Prerequisite: Ed. 432b or 432c. *Mr. Murphy*
536. READING CLINIC RESEARCH (1-15) Prerequisites: Ed. 432b; or Ed. 432c, 432g. *Mr. Murphy*
- 537S. (Bot. 537S, Zool. 537S). WORKSHOP IN THE BIOLOGICAL SCIENCES (3) Projects designed for teachers of biology in the secondary schools.
540. PROBLEMS OF ELEMENTARY EDUCATION (2-3) Problems seminar for experienced educators. Prerequisite: 12 credits in education and psychology, including 6 in elementary education.
541. SEMINAR IN CONTEMPORARY ISSUES IN ELEMENTARY EDUCATION (1-3) Conferences and discussions designed to meet the needs of experienced teachers and principals in the field of elementary education. Prerequisite: 6 credits in elementary education and teaching experience.
546. ELEMENTARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3)
548. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3) Principles underlying curriculum construction. Primarily for elementary education majors. Prerequisite: Ed. 31 or teaching experience.

EDUCATION

550. **PROBLEMS IN MODERN SECONDARY EDUCATION (1-4)** Historical, psychological, social, and economic factors influencing secondary education; required as basic course of all graduate students in secondary education. Prerequisite: secondary school teaching. *Mr. Butler*
551. **SEMINAR IN CONTEMPORARY ISSUES IN SECONDARY EDUCATION (2-9)**
Unit A. The Secondary School Curriculum (2-3) Principles and philosophy of curriculum construction. Each student works out an individual problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience. *Mr. McNerney*
Unit B. Laboratory Studies in Application of Educational Method (2-3) Analysis and application of outstanding studies in secondary education; integration of results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.
Unit C. Organization and Administration of Secondary Education (2-3) Problems in reorganization of secondary education, with particular reference to philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology and teaching experience. *Mr. Remaley*
556. **THE SECONDARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3)** Improvement of instruction; improvement of teachers in service; evaluation of teaching procedures; methods of supervision; selection and use of textbooks. Prerequisite: three years' teaching experience. *Mr. McGarey*
561. **THE COMMUNITY COLLEGE AND POST-SECONDARY SCHOOL EDUCATION (2-3)** Philosophy, organization, and character of school programs needed to meet educational needs of individuals who desire to continue their education on the post-secondary school level. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. *Messrs. Patrick and Brown*
562. **THE INSTRUCTIONAL PROGRAM IN COMMUNITY COLLEGES AND POST-SECONDARY EDUCATION (2-3)** Course offerings, curriculums, instructional materials and procedures, guidance, extracurricular activities, student personnel, evaluation of results, and faculty qualifications. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience.
563. **THE PROFESSIONAL EDUCATION OF TEACHERS (3)** Development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff. Prerequisite: 6 credits in advanced courses in education and a course in educational psychology. *Mr. Patrick*
564. **RECENT TRENDS IN HIGHER EDUCATION (2-3)** Factors affecting current college enrollment, organization, administration, support, and curriculums, with special emphasis on general education, its development, aims, and forms. *Mr. Brown*
565. **THE PRINCIPLES OF COLLEGE TEACHING (2-3)** Principles involved in teaching at the college level; effective use of teaching aids; criteria used in evaluation. *Mr. Brown*
566. **STUDENT PERSONNEL PROGRAMS AT THE COLLEGE LEVEL (2-3)** Student personnel services in higher education; organization of student advisory programs; use of personnel data; co-curricular activities; student welfare. *Mr. Wellington*

567. GROWTH AND ORGANIZATION OF HIGHER EDUCATION (2-3) Growth of higher education; influence of church, state, federal government; educational, social, and economic factors that have affected curriculums and organization of institutions. *Mr. Brown*
568. CURRICULUMS IN HIGHER EDUCATION (2-3) Various types of curriculums and philosophies underlying them; ways in which curriculums are developed; elective versus required courses; evaluation of achievement. *Mr. Brown*
569. SEMINAR IN COLLEGIATE EDUCATION (1-6) Special topics in higher education. Prerequisite: Ed. 567. *Mr. Weaver*
574. ADVANCED EDUCATIONAL STATISTICS (2-4) Appropriate measures and devices for experimental research in education including correlation measures, curve fitting, and analysis of variance. Prerequisite: 12 credits of graduate work in education including Ed. 470 or Psy. 415. *Mr. Davison*
575. ADMINISTRATION AND SUPERVISION IN BUSINESS EDUCATION (3) Work of administrators, supervisors, and others responsible for improvement of instruction in business education; use of vocational testing; job analysis. Prerequisite: 6 credits in secondary education. *Mr. Gemmell, Miss Veon*
576. INTRODUCTION TO RESEARCH IN BUSINESS EDUCATION (3) Methods of research in business education; opportunity to compile annotated bibliographies on current problems; analysis and evaluation of significant research. *Mr. Gemmell*
577. EVALUATION OF RESEARCH AND EMPIRICAL LITERATURE IN BUSINESS EDUCATION (3) Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576. *Mr. Gemmell*
578. SEMINAR IN BUSINESS EDUCATION (1-6) Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577. *Mr. Gemmell*
580. SEMINAR IN SCHOOL ADMINISTRATION (1-6) Efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, stimulating cooperative work. Prerequisites: Ed. 480, 6 credits of Ed. 583.
582. EDUCATIONAL SURVEY TECHNIQUES (2-3) Methods for appraisal of an educational program; planning for expansion, consolidation, or reduction of educational offerings. Prerequisites: Ed. 480, 6 credits of Ed. 583.
- 583, 583X. PROBLEMS IN ADMINISTRATION AND SUPERVISION (2-25) Prerequisite: Ed. 480 or teaching or administrative or supervisory experience.
- Unit A. *The Educational Plant* (2-3)
 - Unit B. *Public Relations for School Administrators* (2-3)
 - Unit C. *Public School Finance* (2-3)
 - Unit F. *State and National Education Programs* (2-3)
 - Unit I. *Administration of Adult Education in the Public Schools* (3)
 - Unit M. *Legal Aspects of School Administration* (3)
 - Unit P. *The Administration of Public School Education for Atypical Children* (2-3)
 - †Unit Q. *Dynamic Factors in School Administration* (2-3)
 - †Unit R. *Public School Business Administration* (2-3)

† These two units are not approved for extension.

EDUCATION

585. CURRICULUM CONSTRUCTION (2-3) Functions of administrators, supervisors, teachers, pupils, and laymen in curriculum building to meet pupil and community needs. *Mr. McGarey*
586. PRINCIPLES OF SCHOOL SUPERVISION (2-3) Organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests and teacher rating. Prerequisite: 18 credits in education and 3 years' teaching experience. *Mr. McNerney*
587. THE SECONDARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-4) Problems of schedule making, teachers' meetings, curriculum making and revision, organization of extracurricular and guidance programs. Prerequisite: teaching experience.
589. THE ELEMENTARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-3) Duties of the elementary school principal in organizing and administering his school. Prerequisite: Ed. 442.
590. PHILOSOPHY OF EDUCATION (2-4) Fundamental principles; scientific sanctions of progressive instructional practices and professional experiences as bases for formulation of the educational creed. Prerequisite: 18 credits in education. *Mr. Chiappetta*
591. EDUCATION IN RUSSIA, ASIA, AND THE MIDDLE EAST (2-3) Current educational activities in Soviet Russia and other eastern European countries; the Middle East, North Africa, and the Far East. *Mr. Chiappetta*
592. EDUCATION IN THE LATIN-AMERICAN COUNTRIES (2-3) Recent educational progress in Central and South America, with special reference to Mexico, Cuba, Puerto Rico, Brazil, Chile, and Argentina.
594. SEMINAR IN EDUCATION (1-3) Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: 12 credits of graduate work in education. *Messrs. Long, Davison, and Russell*
- 597S. WORKSHOP IN CURRENT EDUCATIONAL PROBLEMS (1-6) For administrators, supervisors, experienced elementary and secondary teachers, guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Prerequisite: 12 credits of graduate work in education.

ELECTRICAL ENGINEERING †

PROFESSOR ARTHUR H. WAYNICK, *Head of the Department*

The Master of Science and Doctor of Philosophy degrees are offered with a major in Electrical Engineering. Courses are provided in electrical engineering and electrical engineering laboratory.

415. ILLUMINATION (3) *Mr. Marsh*
- 421a,b,c,d. ELECTRICAL ENGINEERING PROBLEMS (2-12)
422. CREATIVE ELECTRICAL ENGINEERING (3)
423. TRANSIENT PHENOMENA (3) *Mr. Holt*
424. POWER FREQUENCY ELECTRONICS (3) *Mr. Shields*
425. SYMMETRICAL COMPONENTS (3) *Mr. Holt*
426. TRANSISTORS (3) *Mr. Riddle*

ELECTRICAL ENGINEERING

- 428, 428X. SERVOMECHANISMS (3) *Mr. Tarpley*
 432. ULTRA-HIGH-FREQUENCY TECHNIQUES (3) *Mr. Hall*
 434. INDUSTRIAL ELECTRONICS (3) *Mr. Stavelly*
 435, 435X. ENGINEERING ANALYSIS (3) *Mr. Tarpley*
 436. DESIGN, CONSTRUCTION, AND TESTING OF VACUUM TUBES (3) *Mr. Nearhoof*
 438. FUNDAMENTALS OF ELECTRIC WAVES (3) *Mr. Mentzer*
 439. PULSE TECHNIQUES (3)
 440, 440X. VACUUM-TUBE CIRCUITS I (3)
 441, 441X. VACUUM-TUBE CIRCUITS II (3)
 450, 450X. ELECTRICAL NETWORK THEORY (3) *Mr. Tarpley*
 460. HIGH-VOLTAGE ENGINEERING (3) *Mr. Armington*
 461. FUNDAMENTALS OF POWER SYSTEM STABILITY (3) *Mr. Shields*
 470. ELECTRONIC ANALOG COMPUTERS (3)
 471. LOGICAL DESIGN OF DIGITAL COMPUTERS (3)
 520. SEMINAR (1) Required of all graduate students in electrical engineering. Conferences, reading, and presentation of technical papers.
 521a,b,c,d. ALTERNATING-CURRENT THEORY (2-12) Special problems in alternating-current theory and application of these problems to alternating-current circuits or machinery at any frequencies.
 522. PUBLIC UTILITIES (3) Problems in the public utility field, especially those involving electrical engineering. *Mr. Powell*
 523. TRANSIENTS IN LINEAR SYSTEMS (3) Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E.E. 423. *Mr. Holt*
 524. ENGINEERING ELECTRONICS (3) Special problems dealing with design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program. *Mr. Stavelly*
 525. SYMMETRICAL COMPONENTS (3) Polyphase circuits and machines under unbalanced conditions of operation including effects of rotating machines upon distribution and transmission system performance; characteristics of phase converters and single-phase operation of polyphase systems. Prerequisite: E.E. 425. *Mr. Holt*
 528. SERVOMECHANISMS (3) Advanced treatment of transient and steady-state behavior of closed-cycle control systems with special attention to stability and design of stabilizing controllers. Prerequisite: E.E. 428. *Mr. Tarpley*
 530. AUDIO FREQUENCY ENGINEERING (3) Electrical systems and equipment used in production, recording, amplification, transmission, and measurement of sound. Prerequisite: E.E. 11 or 13.
 531a,b,c. RADIO FREQUENCY ENGINEERING (3-9) Radio frequency equipment, measurements, and systems; amplifiers, modulators, demodulators, transmitters, receivers, transmission lines, antennae, and radiators. Prerequisite: E.E. 440.
 532. ULTRA-HIGH-FREQUENCY ENGINEERING (4) Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E.E. 432. *Mr. Hall*

ELECTRICAL ENGINEERING

533. AUTOMATIC CONTROL SYSTEMS (2-3) Automatic control, telemetering, and recording of electrical, mechanical, thermal, and chemical quantities. Prerequisite: E.E. 4.
535. ENGINEERING ANALYSIS (3) Engineering applications of complex variables, conformal mapping methods and potential plotting. Laplace transform methods and stability criteria. Prerequisite: E.E. 435.
538. ELECTROMAGNETIC ENGINEERING (3) Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E.E. 438.
550. COMMUNICATION NETWORKS (3) Methods of filter design using lattice networks; effects of dissipation on characteristics of filter networks; transient response of networks and design of equalizers. Prerequisite: E.E. 450. *Mr. Tarpley*
570. ADVANCED ELECTRONIC ANALOG COMPUTERS (3) Theory and design of linear and nonlinear function generators for electronic analog computers; methods of synthesizing physical systems. Prerequisite: E.E. 470.
571. DIGITAL COMPUTATION AND CONTROL (3) Methods of analysis of digital computers; analysis of sampled-data systems for real-time control purposes.

ELECTRICAL ENGINEERING LABORATORY

440. ELECTRICAL COMMUNICATIONS LABORATORY I (1½)
441. ELECTRICAL COMMUNICATIONS LABORATORY II (1½)

ENGINEERING MECHANICS †

PROFESSOR JOSEPH MARIN, *Head of the Department*

- 400, 400X. ADVANCED STRENGTH OF MATERIALS (3) *Mr. Hardenbergh*
- 401, 401X. ELEMENTS OF VIBRATIONS (3) *Mr. Vierck*
- 402, 402X. APPLIED AND EXPERIMENTAL STRESS ANALYSIS (3) *Messrs. Marin and Hu*
- 403, 403X. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) *Mr. Marin*
- 404, 404X. RESEARCH IN ENGINEERING MECHANICS (1-6)
406. ENGINEERING APPLICATIONS OF FLUID MECHANICS (3) *Mr. Ranz*
407. NUMERICAL METHODS OF ANALYSIS (3) *Mr. Vierck*
408. ELASTICITY AND ENGINEERING APPLICATIONS (3) *Mr. Hardenbergh*
500. ADVANCED MECHANICS OF MATERIALS (3-6) Strain energy methods; special problems in bending and torsion; curved bars, beams on elastic foundations; thick-walled cylinders, shrink-fit assemblies, and rotating discs; thin-walled pressure vessels; bending of thin plates; buckling of bars and plates. Prerequisite: Mchs. 13. *Messrs. Marin and Hardenbergh*
504. APPLIED ELASTICITY (3) Analyses of stress and strain in two dimensions; problems in elasticity and elastic stability; emphasis on applications to machine and structural design. Prerequisite: Mchs. 13. *Mr. Marin*

506. **EXPERIMENTAL STRESS ANALYSIS (3)** Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; stress analogies; strain rosettes for combined stress determinations. Prerequisite: Mchs. 13. *Messrs. Marin and Hu*
507. **THEORY OF ELASTICITY AND APPLICATIONS (3)** Equations of equilibrium and compatibility; stresses and strains in beams, curved members, rotating discs, thick cylinders, torsion and structural members. Prerequisite: Mchs. 13. *Mr. Rongved*
508. **THEORY OF ELASTIC STABILITY AND APPLICATIONS (3)** Buckling of slender and short members; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to internal pressures; applications to structural parts including aircraft members. Prerequisites: Mchs. 12, 13.
509. **THEORY OF PLATES AND SHELLS (3)** Bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without bending; applications to engineering problems. Prerequisite: Mchs. 13. *Messrs. Davids and Rongved*
514. **ENGINEERING MECHANICS SEMINAR (1 per semester)** Current literature and special problems in engineering mechanics.
516. **MATHEMATICAL THEORY OF ELASTICITY (3)** Stress and strain dyadics; conditions for single valued displacement; incompatibility dyadic; generalized Hooke's Law; uniqueness theorem; special topics in elasticity. Prerequisites: Math. 417, 405. *Mr. Rongved*
520. **ADVANCED DYNAMICS (3)** Dynamics of a particle and of rigid bodies; Newtonian equations in moving co-ordinate systems; LaGrange's and Hamilton's equations of motion; special problems in vibrations and dynamics. Prerequisites: Mchs. 12, Math. 84 or 431. *Messrs. Davids and Sauer*
522. **THEORY OF VIBRATIONS (3)** Mathematical theory of vibrating systems; damping phenomena; forced vibrations; analogy between mechanical and electrical vibrations; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: Mchs. 13, Math. 84 or 431. *Mr. Vierck*
523. **RELAXATION METHODS (3)** Relaxation methods compared to iteration and other numerical methods of analysis; application to elasticity, plasticity, stability, fluid flow, heat transfer, and related fields. Prerequisites: Mchs. 13 or 111, Math. 44. *Mr. Vierck*
524. **MATHEMATICAL METHODS IN ENGINEERING (3-6)** Prerequisite: Math. 451 or E.E. 435 or M.E. 452. *Mr. Davids*
- Unit A (3)* Matrix and tensor analysis, finite differences, relaxation, perturbation, and other approximate methods in solution of various engineering problems.
- Unit B (3)* Energy methods, potentials, application to torsion problems, non-linear problems, analogies and dimensional analysis, Bessel and other special functions, harmonic analysis.
526. **NONLINEAR MECHANICS (3)** Integral curves, singular points, self-sustained oscillations, stability problems, Hill's and Van der Pol's equation, mechanical and electrical applications. Prerequisite: Mchs. 522.

ENGINEERING MECHANICS

528. EXPERIMENTAL METHODS IN VIBRATIONS (3) Investigation of one or more degrees of freedom, free and forced mechanical vibrations, vibration properties of materials, vibration techniques in nondestructive testing. Prerequisite: Mchs. 401 or 522. *Mr. Brennan*
530. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for static and fatigue stresses; impact loads; creep of metals; applications to structural and machine design. Prerequisite: Mchs. 14. *Mr. Marin*
531. THEORY OF PLASTICITY AND APPLICATIONS (3) Theory of plasticity including plastic torsion and bending of bars; thick-walled cylinders and rotating discs; buckling of bars and residual stresses; mechanics of creep. Prerequisite: Mchs. 504 or 507. *Mr. Marin*
533. DETERMINATION OF MECHANICAL PROPERTIES (3) Experimental methods for determining hardness, elastic constants, creep behavior, fatigue strength, plastic flow, and dynamic properties of metals. Prerequisite: Mchs. 14 or 530. *Mr. Hu*
534. PHOTOELASTICITY (3) Analysis of polariscopes; isoclinics, isochromatics, and stress trajectories; two- and three-dimensional photoelastic methods; determination of principal stresses; model preparation.
540. MECHANICS OF CONTINUA (3) Unified mathematical treatment of elements of fluid mechanics and of elasticity and plasticity of solids. Prerequisite: Math. 84 or 431.

ENGLISH †

PROFESSOR THEODORE J. GATES

Head of the Department of English Composition

PROFESSOR BRICE HARRIS

Head of the Department of English Literature

The master's degree and the doctorate are offered with a major in English. Courses are designated as English Composition, English Literature, and English.

ENGLISH COMPOSITION

404. PUBLIC OPINION AND WRITTEN PERSUASION (3) *Mr. Graves*
408. ENGLISH GRAMMAR (3)
418. THE WRITING OF LITERARY CRITICISM (3) *Mr. Bressler*
442. CONTEMPORARY PROSE STYLE (3) *Mr. Major*

ENGLISH LITERATURE

400. TEACHERS' COURSE IN LITERATURE (3)
 401. MAIN CURRENTS IN AMERICAN LITERATURE (3)
 423. FORMS AND MOVEMENTS OF BRITISH LITERATURE (3) *Mr. Ridenour*
 439S. OUR CONTEMPORARIES (3)
 440. MASTERS OF BRITISH LITERATURE (3)
 441. MASTERS OF AMERICAN LITERATURE (3)
 460. LITERARY BIOGRAPHY (3)
 464. SPENSER (3) *Miss Locklin*
 466. MILTON (3) *Mr. Condee*
 480. THE DRAMA BEFORE SHAKESPEARE (3)
 481. JACOBAN AND CAROLINE DRAMA (3) *Mr. Harris*
 484. AMERICAN DRAMA (3) *Mr. Rubin*
 486. LATER BRITISH AND IRISH DRAMATISTS (3)
 487. MODERN CONTINENTAL DRAMA (3)
 488. THE DRAMA FROM DRYDEN TO SHERIDAN (3) *Mr. Harris*

ENGLISH

501. MATERIALS AND METHODS OF RESEARCH (3) Bibliography of literary history and criticism; methods of editing and annotating texts; form and materials of dissertations. Required of all graduate students with an English major. *Mr. Ridenour*
 502. CLASSICAL ORIGINS OF ENGLISH PROSE AND POETIC THEORIES (3) Rhetorical and poetic doctrine of ancient and medieval times. *Mr. Reed*
 507. RESEARCH PROBLEMS IN ENGLISH (1-6) Methods of research in English, problems of bibliography, and method of evaluating sources and materials.
 508. BEOWULF (3) Reading of the text and study of the prominent literary problems and relationships. *Mr. Mead*
 509. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE PROSE WRITERS (3) *Mr. Mead*
 510. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE POETS (3) *Miss Locklin*
 514. SHAKESPEARE (3) Special problems in the works of Shakespeare. *Mr. Bowman*
 515. THE AGE OF SWIFT (3) Special studies varying from year to year. *Mr. Harris*
 516. THE AGE OF JOHNSON (3) The work of Johnson and his circle. *Mr. Mead*
 517. BYRON, SHELLEY, AND KEATS (3) *Mr. Ridenour*
 518. PRE-ROMANTIC WRITERS (3) Development of Romantic ideas in the 18th century. *Mr. Ridenour*
 519. WORDSWORTH, COLERIDGE, SOUTHEY, AND SCOTT (3) *Mr. Ridenour*
 530. HISTORY OF THE ENGLISH LANGUAGE (3) Germanic background of English, phonological and morphological developments, dialect differentiations, and principles of linguistic change. *Mr. Mead*

ENGLISH

531. OLD ENGLISH (3) Old English language and literature with lectures on Old English and Germanic philology. *Mr. Mead*
532. MIDDLE ENGLISH (3) Middle English language and literature with lectures on the development of Old English through middle English to modern times. *Mr. Mead*
534. HISTORICAL ENGLISH GRAMMAR (3) Evolution of the grammatical system of English. *Mr. Peck*
535. RENAISSANCE AND MODERN RHETORIC (3) The rhetorical and poetic doctrine of Renaissance and modern times. *Mr. Bressler*
540. CHAUCER (3) Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences. *Mr. Mead*
542. PROSE STYLE (3) Development of English prose style. *Mr. Major*
543. CAVALIER AND ANGLICAN (3) Poetry and prose of the middle years of the 17th century from the death of Shakespeare to 1660. *Mr. Mead*
544. RESTORATION LITERATURE (3) Selected studies of writers in England between 1650 and 1700. *Mr. Harris*
545. POETS OF THE VICTORIAN PERIOD, EXCLUSIVE OF TENNYSON AND BROWNING (3) *Mr. Long*
546. TENNYSON AND BROWNING (3) *Mr. Long*
547. PROSE WRITERS OF THE VICTORIAN PERIOD (3) *Mr. Long*
550. SELECTED STUDIES IN THE BRITISH NOVEL TO 1840 (3) *Mr. Bowman*
551. SELECTED STUDIES IN THE BRITISH NOVEL FROM 1840 TO THE PRESENT (3) *Mr. Sutherland*
562. THE AMERICAN NOVEL (3) *Mr. Werner*
563. AMERICAN ESSAYS (3) Lectures and reports on a special group of essayists. *Mr. Werner*
565. THE AMERICAN SHORT STORY (3) *Mr. Werner*
566. AMERICAN POETRY (3) *Mr. Werner*
567. ANGLO-AMERICAN FOLK SONG (3) Oral tradition of melodies and texts; types, regions, theories. *Mr. Bayard*

ENTOMOLOGY *

PROFESSOR BERTIL G. ANDERSON

Head of the Department of Zoology and Entomology

401. MEDICAL AND VETERINARY ENTOMOLOGY (3) *Mr. Frings*
403. SYSTEMATIC ENTOMOLOGY (3) *Mr. Rutschky*
405. INSECT MORPHOLOGY (3) *Mr. Rutschky*

407. INSECT ECOLOGY (3) *Mr. Frost*
 413. ENTOMOLOGY SEMINAR (1 per semester) *Mr. Frost*
 429. PRINCIPLES OF INSECT CONTROL (3) *Mr. Blackburn*
 430. INSECT HISTOLOGY (2) *Mr. Rutschky*
 431. ENTOMOLOGICAL PROBLEMS (1-6)
 445S. THE IDENTIFICATION OF INSECTS (3) *Mr. Frost*
505. ADVANCED MORPHOLOGY OF INSECTS (3) Advanced work in either external or internal morphology of insects. Prerequisites: Ent. 403, 405. *Mr. Rutschky*
506. IMMATURE INSECTS (3) The morphology and taxonomy of the immature stages of insects. Prerequisite: 9 credits in entomology. *Mr. Blackburn*
508. THE BIOLOGICAL CONTROL OF INSECTS (2) Artificial use of bacteria, fungous diseases, and animals in control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 6, 8, 407. *Mr. Frost*
509. ENTOMOLOGICAL TECHNIQUE (2) For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 6. *Mr. Frost*
514. ADVANCED SYSTEMATIC ENTOMOLOGY (1-15 per semester) Taxonomy of various orders of insects selected to meet the needs of the individual student. Prerequisites: Ent. 403, 405. *Mr. Rutschky*
528. INSECT PHYSIOLOGY (3) Normal functions of the insect body. Prerequisites: Ent. 405, A.B.Ch. 1.

FINE ARTS *

PROFESSOR ANDREW W. CASE, *Acting Head of the Department of Art*

The Master of Arts degree is offered with a major in Fine Arts, but the courses are designated simply as Art.

ART

400. OIL PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-12)
 403S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Mr. Dickson*
 404S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Mr. Dickson*
 410. WATER-COLOR PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9) *Mr. Case*
 420. APPLIED DESIGN (3-9)
 442S. ART OF THE MIDDLE AGES AND RENAISSANCE IN ITALY (3)
 443S. ART IN AMERICA (3)
 444S. ART IN NORTHERN EUROPE (3)
 490. LIFE DRAWING (3) *Mr. Case*

FINE ARTS

500. ART RESEARCH (2-6) Prosecution of assigned problems under the guidance of an instructor. *Mrs. Galbraith*
501. ITALIAN PAINTING (2-6) Investigations of early Italian painting. Seminar, written reports. *Mr. Dickson*
502. MEDIEVAL SCULPTURE (2-6) Sculpture of Italy and France from the 9th to the 13th centuries. Seminar, written reports. *Mr. Norton*
503. ART HISTORY RESEARCH (3-12) Original investigation in art history, to be pursued independently or concurrently with course work in particular fields. Prerequisite: 6 credits in history of art. *Mr. Dickson and Staff*
504. SEMINAR: ART LITERATURE AND ICONOGRAPHY (2-6) Methods of research in the fine arts; survey of the literature of art; studies in iconography. Prerequisite: 6 credits in history of art. *Mr. Dickson and Staff*

FOODS * AND NUTRITION †

PROFESSOR MIRIAM E. LOWENBERG, *Head of the Department*

The master's degree and the doctorate are offered in the field of Nutrition, only the master's degree in the field of Foods. The Master of Science degree in Nutrition in Public Health is offered in a co-operative program with the University of Pittsburgh. Courses are given under the designation Foods, Nutrition, and Health.

FOODS, NUTRITION, AND HEALTH

400. SPECIAL PROBLEMS IN FOODS AND NUTRITION (1-3)
420. EXPERIMENTAL COOKERY (1-6) *Miss Olson*
421. ADVANCED FOODS (3)
- 423, 423X. (H.Mgmt. 423). FAMILY FOOD PURCHASING (2)
425. FOOD PRESERVATION (2) *Miss Hester*
- 426S. RECENT DEVELOPMENTS IN FOODS (3)
450. NUTRITION (4) *Miss Padgett*
451. RECENT DEVELOPMENTS IN NUTRITION (3)
452. ELEMENTS OF DIET IN DISEASE (3) *Miss Pike*
- 455, 455X. TEACHING NUTRITION TO BOYS AND GIRLS (3)
456. NUTRITION IN THE COMMUNITY (3) *Miss Lowenberg*
- 491, 491v. TEACHING HOME NURSING (1)
520. READINGS IN FOODS (2) Critical review and reports of literature on selected food topics. *Miss Hester*

521. SEMINAR IN FOODS (1-6) Discussion and reports on current research in the foods field. Prerequisite or concurrent: Fd.Ntr. 520. *Miss Hester*
522. ADVANCED EXPERIMENTAL FOODS (3) Experimental methods used in measuring the quality of foods; specific problems in food preparation. *Miss Hester*
530. PROBLEMS IN FOODS AND NUTRITION (1-6)
- 531, 531X. ADVANCES IN FOODS AND NUTRITION (3) Recent findings in the related areas of foods and nutrition.
550. READINGS IN NUTRITION (3) Readings and reports of selected topics in nutrition. Prerequisite: Fd.Ntr. 450. *Miss Padgett*
551. SEMINAR IN NUTRITION (1-6) Selected topics and recent advances in nutrition.
552. DIET IN DISEASES (3) Physiological and biochemical problems in metabolic diseases and the nutritional aspects of therapy. *Miss Pike*
553. NUTRITION OF CHILDREN (3) Nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: A.B.Ch. 35, Fd.Ntr. 450. *Miss Padgett*
555. FIELD WORK IN NUTRITION (2-4) Field problems planned to meet the needs of individual students. Hours and problems to be arranged.
556. THE SURVEY METHOD IN FOODS AND NUTRITION (2) Study of survey technique as a tool in the assay of food adequacy and nutritional status. *Miss Dodds*
557. INTERRELATIONSHIPS OF NUTRIENTS (2) Interrelationships of nutrients in the metabolic processes; their significance as applied to nutrition. *Miss Pike*

FORESTRY *

PROFESSOR WILLIAM C. BRAMBLE

Head of the Department of Forest Management

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| 404. MECHANICAL PROPERTIES OF WOOD (3) | <i>Mr. Nearn</i> |
| 405. VENEER AND PLYWOOD (3) | <i>Messrs. Norton and Nearn</i> |
| 421. REGIONAL SILVICULTURE (4) | <i>Mr. Cope</i> |
| 427. FOREST RANGE MANAGEMENT (3) | <i>Mr. Chisman</i> |
| 431. PROBLEMS IN FOREST PRODUCTS (3-6) | <i>Messrs. Norton and Nearn</i> |
| 435. SEASONING AND PRESERVATION (3) | <i>Mr. Nearn</i> |
| 437. ADVANCED WOOD TECHNOLOGY (3) | <i>Messrs. White and Jorgensen</i> |
| 445. IMPROVEMENTS (3) | <i>Mr. Worley</i> |
| 450. ADVANCED MENSURATION (2) | |
| 455. AERIAL PHOTOGRAMMETRY IN FOREST MANAGEMENT (2) | <i>Mr. Worley</i> |
| 462. DEFECTS IN WOOD (3) | <i>Mr. Norton</i> |
| 466. FOREST MANAGEMENT AND MANAGEMENT PLANS (4) | |
| 468. SILVICULTURAL RESEARCH (3-6) | <i>Mr. Chisman</i> |

FORESTRY

469. PROBLEMS IN FOREST MANAGEMENT (3)
475. PROBLEMS IN FOREST ECONOMICS AND FINANCE (3) *Mr. Humphrey*
480. POLICY AND ADMINISTRATION (3)
491. LUMBERING (3) *Mr. Schmidt*
492. LUMBER DISTRIBUTION (3) *Mr. Schmidt*
495. MILLING AND COSTS IN LUMBER INDUSTRY (3) *Mr. Schmidt*
497. SMALL SAWMILLS (3) *Mr. Schmidt*
502. WOOD FIBERS (3-5) Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulping quality, fiber measurements. *Mr. White*
504. RESEARCH METHODS IN FORESTRY (2-6 per semester) Review of methods employed in conducting forestry research. *Mr. Bramble*
508. FOREST ECOLOGY (2-4) Organization, development, and classification of forest communities. *Mr. Bramble*
509. COVERT MANAGEMENT (2) Management of forest associations for maintenance and development of wildlife. Prerequisite: For. 508. *Mr. Bramble*
510. SEMINAR (1-2 per semester) Current problems of forest research presented as weekly seminar reports. May be repeated with additional credit for each semester's work. *Mr. Bramble*
530. PROBLEMS IN WOOD UTILIZATION (3-6 per semester) Prerequisite: For. 431. *Mr. Norton*
531. STRUCTURAL USES OF WOOD AND WOOD PRODUCTS (3-6 per semester) Wood as a construction material; testing techniques for structural timbers and wood assemblies; use of laminated wood, ring connectors, and other types of special construction. Prerequisite: For. 404. *Mr. Norton*
532. LAMINATES (3-6 per semester) Advanced and special studies in fabrication and use of plywood, laminated wood, paper-base laminates, and wood-to-metal bonding. Prerequisite: For. 405. *Mr. Norton*
535. CONDITIONING TREATMENTS FOR WOOD (3-6 per semester) Advanced study and problems in preservative, seasoning, and other special treatments for wood and wood products. Prerequisite: For. 435. *Mr. Norton*
550. FOREST MENSURATION (2-8 per semester) Research in some chosen field. Prerequisite: For. 450.
560. FOREST MANAGEMENT (3-8) Special topics in forest management and research in some chosen field. Prerequisite: For. 466.
575. APPLICATIONS OF FOREST ECONOMICS AND FINANCE (3 per semester) Survey of situations in forestry where business problems and particular circumstances of production, value, and costs are currently significant. Prerequisite: For. 70. *Mr. Humphrey*
590. THE LUMBER INDUSTRY (2-4) Relation of the lumber industry to national economy and world trade; lumbermen's associations; lumber accounts.
591. PROBLEMS IN LUMBERING (2-6) Research in some chosen phase of lumbering. Prerequisite or concurrent: For. 590.

FUEL TECHNOLOGY†

PROFESSOR PHILIP L. WALKER, JR., *Head of the Department*

400. FUEL TECHNOLOGY RESEARCH AND DESIGN (1-3)
401. FUEL GASES AND GASIFICATION (3)
402. CHEMICALS FROM FUELS (2) *Mr. Kinney*
404. FUEL TECHNOLOGY DESIGN (3) *Mr. Spicer*
405. COMBUSTION CALCULATIONS (3) *Mr. Grace*
406. GASEOUS COMBUSTION (3)
407. COMBUSTION ENGINEERING LABORATORY (2)
408. COMBUSTION TECHNOLOGY (3) *Mr. Spicer*
502. RESEARCH DATA (3) Designed for the graduate student beginning laboratory research; methods of obtaining and interpreting research data. Prerequisite: Math. 30. *Mr. Nielsen*
503. CHEMICAL CONSTITUTION AND SCIENTIFIC CLASSIFICATION OF COAL (3-6) Chemistry of plant constituents in relation to coal and the coalification process; constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. *Mr. Kinney*
505. PHYSICOCHEMICAL PROPERTIES OF COAL, MINERAL MATTER, AND ASH (3) Physical, physicochemical, and use properties; their significance and applications. Prerequisite: Chem. 461.
506. ADVANCED SOLIDS COMBUSTION (3) Current approaches to heterogeneous reactions in combustion and gasification of coals and carbons. Prerequisite: Chem. 461. *Mr. Walker*
507. ADVANCED THERMAL PROCESSING (3) Pyrolysis, coal carbonization, coke manufacture and uses; action of heat on coals and fuels; technical and economic factors. Prerequisites: Chem. 35, 461, or Min.Pr. 410. *Mr. Polansky*
508. SYNTHESIS OF LIQUID FUELS (3) Chemical nature of liquid hydrocarbons; preparation of hydrogen and synthesis gas; theoretical and practical aspects of synthetic liquid fuel processes. Prerequisites: Chem. 31, Fuel T. 402. *Mr. Kinney*
509. TECHNOLOGY OF TARS (3) Formation, constitution, physical and chemical properties of coal, oil-gas and water-gas tar; processing and utilization. Prerequisite: Chem. 31. *Mr. Polansky*
510. FUEL TECHNOLOGY PROBLEM (1-6 per semester) Special problems in fuel technology. Prerequisite: Fuel T. 503.
511. FUEL TECHNOLOGY SEMINAR (1-6) Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 461. *Mr. Kinney and Staff*
512. ADVANCED GASEOUS COMBUSTION (3) Theories of reaction mechanisms; measurement of gaseous combustion parameters; review of current literature. Prerequisite: Fuel T. 406. *Mr. Palmer*

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in fuel technology studies are listed under Mineral Sciences in Part II of this bulletin.

GENERAL HOME ECONOMICS †

PROFESSOR DOROTHY HOUGHTON

Assistant Dean of the College of Home Economics

The master's degree and the doctorate are offered in the field of General Home Economics. Candidates select courses for this major from a number of related fields.

400, 400v, 400X, 400vX. RECENT FINDINGS IN HOME ECONOMICS (2-3)

516, 516v. METHODS OF RESEARCH IN HOME ECONOMICS (3) Review of problems and techniques of research in home economics. Required of all graduate students in home economics. *Miss Hatcher*

530. SELECTED PROBLEMS IN GENERAL HOME ECONOMICS (1-6)

GEOGRAPHY †

PROFESSOR E. WILLARD MILLER, *Head of the Department*

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| 400. REGIONAL GEOGRAPHY OF NORTH AMERICA (3) | <i>Mr. Deasy</i> |
| 401. REGIONAL GEOGRAPHY OF PENNSYLVANIA (3) | <i>Mr. Miller</i> |
| 403. REGIONAL GEOGRAPHY OF SOUTH AMERICA (3) | <i>Mrs. Griess</i> |
| 405. GEOGRAPHY OF POPULATION AND SETTLEMENT (3) | <i>Mr. Rodgers</i> |
| 420. URBAN GEOGRAPHY (3) | <i>Mr. Rodgers</i> |
| 427S. REGIONAL GEOGRAPHY OF THE SOVIET UNION (3) | <i>Mr. Rodgers</i> |
| 433. REGIONAL CLIMATOLOGY (3) | <i>Mr. Wernstedt</i> |
| 435. FIELD METHODS IN GEOGRAPHY (3) | <i>Mr. Miller</i> |
| 442. GEOGRAPHY OF EUROPE (3) | <i>Mr. Miller</i> |
| 443. GEOGRAPHY OF THE ORIENT (3) | <i>Mr. Wernstedt</i> |
| 444. GEOGRAPHY OF AFRICA (3) | <i>Mrs. Griess</i> |
| 452. INTERPRETATION OF AERIAL PHOTOGRAPHS (3) | <i>Mr. Deasy</i> |
| 460. POLITICAL GEOGRAPHY (3) | <i>Mrs. Griess</i> |
| 480. GEOGRAPHY OF WORLD MANUFACTURING (3) | <i>Mr. Miller</i> |

503. ADVANCED REGIONAL GEOGRAPHY (3-12) Intensive study at an advanced level of selected regions or sections of the continents. Prerequisite: 12 credits in geography.

504. PHYSICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions.

505. ECONOMIC GEOGRAPHY SEMINAR (3-12) The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions.

506. CULTURAL AND POLITICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions.

507. DEVELOPMENT OF GEOGRAPHIC THOUGHT (1-6) Critical analysis of the growth of geographic thought from antiquity to the present; emphasis on structure of modern geography.
510. PHYSICAL GEOGRAPHY RESEARCH (3-10) Original study in physical geography: a field problems or detailed library investigation with analysis and presentation of data.
511. ECONOMIC GEOGRAPHY RESEARCH (3-10) Original study in economic geography: a field problem or detailed library investigation with analysis and presentation of data.
512. CULTURAL AND POLITICAL GEOGRAPHY RESEARCH (3-10) Original study in cultural and political geography: a field problem or detailed library investigation with analysis and presentation of data.

GEOLOGY †

PROFESSOR FRANK M. SWARTZ, *Head of the Department*

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| 420. PALEOBOTANY (3) | <i>Mr. Spackman</i> |
| 424. GEOLOGY OF COAL (2) | <i>Mr. Nickelsen</i> |
| 451. ECONOMIC GEOLOGY (3) | <i>Mr. Scholten</i> |
| 455. PHYSIOGRAPHY OF NORTH AMERICA (3) | <i>Mr. Dort</i> |
| 461. GEOLOGY OF THE UNITED STATES (3) | <i>Mr. Nickelsen</i> |
| 462. PRINCIPLES OF GEOMORPHOLOGY (3-6) | <i>Mr. Dort</i> |
| 464. PALEONTOLOGY (3) | <i>Mr. Swartz</i> |
| 481. GEOLOGY OF OIL AND GAS (3) | <i>Mr. Scholten</i> |
| 482. METALLIC MINERAL DEPOSITS (3) | <i>Mr. Ridge</i> |
| 483. STRUCTURAL GEOLOGY (3) | <i>Mr. Nickelsen</i> |
| 484. PALEOZOIC STRATIGRAPHY (3) | <i>Mr. Swartz</i> |
| 485. PALEONTOLOGY (2) | <i>Mr. Swartz</i> |
| 486. STRATIGRAPHIC METHODS (1) | <i>Mr. Swartz</i> |
| 488. EARTH SCIENCES SEMINAR (1) | |
| 489. EARTH SCIENCES REPORT (1) | |

‡500. GEOLOGY SEMINAR (1-9) Presentation, at weekly departmental meetings, of topics selected from geological literature.

§501. STRATIGRAPHY (3-12) Principles of stratigraphic classification, lithofacies and biofacies, faunal zonation, correlation, sedimentation, and paleogeography, illustrated by stratigraphy of classical geologic regions: (a) Pre-Cambrian; (b) Paleozoic; (c) Mesozoic; (d) Cenozoic. Prerequisite: Geol. 464. *Mr. Swartz*

§503. PALEONTOLOGY (3-9) Morphology of animal groups significant for their fossils; nature of species and faunal zones. Seminars may be arranged for studies of special fossil groups, microfossils, paleoecology. *Mr. Swartz*

504. HISTORY OF GEOLOGY (2-3) Development through the ages of the scientific method in earth sciences. *Mr. Krynine*

† Credits to be arranged, 1 to 6 per semester.

§ Credits to be arranged, 3 to 6 per semester.

GEOLOGY

507. SEMINAR IN GEOMORPHOLOGY (3-6) Classic and current literature in geomorphology.
511. ORE DEPOSITS: PRINCIPLES (3-6) Geological and geochemical processes controlling ore deposition; genetic classification of ore deposits. Prerequisite: Geol. 451. *Mr. Ridge*
512. ORE DEPOSITS: TYPES (1-6) Geologic history and field examination of selected ore bodies; forming media; causes, sequences, and loci of emplacement; wall rock alteration; secondary enrichment. Prerequisite: Geol. 511. *Mr. Ridge*
515. ORE MICROSCOPY (2-3) Theory and use of the ore microscope in identifying ore minerals in polished section, establishing paragenetic sequences, determining manner of deposition. *Mr. Ridge*
520. SEMINAR IN PALEOBOTANY (2-6) Current and classic literature concerning evolution, paleoecology, and geologic history of vascular plants. *Mr. Spackman*
524. COAL PETROLOGY (1-6) Microscopy, source materials, coalification, constitution, classification of peats, lignites, bituminous coal, anthracite. *Mr. Spackman*
530. GEOLOGICAL PROBLEMS (3-6) Study, from the literature, of a selected geological problem. Prerequisite: 10 credits in geology and mineralogy.
545. GLACIAL GEOLOGY (3) Glaciers: their characteristics, causes, deposits, land forms, effects in periglacial regions.
551. GEOTECTONICS (3-6) Tectonic principles and elements: nature and development of geosynclines, island arcs, mountain structures, stable masses, cratons, mobile belts. *Mr. Scholten*
555. ADVANCED STRUCTURE AND PETROFABRICS (1-3) Macroscopic and microscopic recognition, measurement, and interpretation of small-scale rock structures and mineral orientation patterns in deformed rocks.
571. PETROLEUM PROVINCES OF THE WORLD (3) Stratigraphy, structure, geologic history, and oil and gas occurrence in major petroliferous provinces. *Mr. Scholten*
590. GEOLOGY FIELD TRIP (1 per year) Field study of regional geologic features with trips in successive years to differing geologic provinces. Required each spring of all graduate students in geology.

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in geological studies are listed under Mineral Sciences in Part II of this bulletin.

GEOPHYSICS † AND GEOCHEMISTRY †

PROFESSOR B. F. HOWELL, JR., *Head of the Department*

The Master of Science and Doctor of Philosophy degrees are offered in the field of Geophysics and in the field of Geochemistry. All courses are designated as Geophysics and Geochemistry.

GEOPHYSICS AND GEOCHEMISTRY

401. ELECTRICAL PROSPECTING (3) *Mr. Moore*
402. SEISMIC PROSPECTING (3) *Mr. Howell*
403. GEOPHYSICS FIELD WORK (1-3) *Mr. Howell*
404. MINING GEOPHYSICS LABORATORY (1)
405. INTRODUCTORY GEOPHYSICS (3) *Mr. Howell*
406. INTRODUCTORY GEOCHEMISTRY (3) *Mr. Keith*
407. WELL LOGGING (2) *Mr. Moore*
408. POTENTIAL THEORY APPLIED TO EARTH PROBLEMS (3) *Mr. Hipple*
409. GEOPHYSICAL PROSPECTING (3) *Mr. Moore*

500. GEOPHYSICAL SEMINAR (1 per semester) Discussion of geophysical reports and papers; scientific outlook. Prerequisites: G.G. 401, 402. *Mr. Howell*
501. RESEARCH (1-15 per semester) Original research in geophysics or geochemistry.
502. SEISMIC INSTRUMENTS (3) Characteristics and design of seismometers and seismic recorders. Prerequisite: Phys. 285, differential equations. Given alternate years. *Mr. Howell*
503. SPECIAL STUDIES IN GEOPHYSICS (1-9) Special studies of the theories of geophysical methods. Prerequisite: 6 credits in geophysics.
507. SEISMOLOGY (3) Nature and transmission of seismic waves; cause and occurrence of earthquakes; applications in seismic prospecting. Prerequisites: Math. 44, Phys. 285. *Mr. Howell*
508. TECTONICS (3) Seminar in the cause and nature of the principal deformations of the earth. Prerequisite: Geol. 483. *Mr. Howell*
509. GEOCHEMISTRY SEMINAR (1 per semester) Prerequisite: G.G. 406. *Mr. Keith*
510. PROBLEMS IN GEOCHEMISTRY (1-9) Laboratory and library study of special problems. Prerequisite: G.G. 406.
512. PRINCIPLES AND METHODS IN HIGH-TEMPERATURE GEOCHEMISTRY (3) Ion configuration and radii; simple crystal structures; measurement and control of temperature and pressure; methods of phase equilibrium determination. *Mr. Roy*
513. PHASE EQUILIBRIA IN MINERAL SYSTEMS (3-6) Phase relations and constitution of inorganic crystals and liquids; special emphasis on systems closely related to natural magmas and rock systems. Prerequisite: G.G. 512. *Mr. Osborn*
514. ELEMENT DISTRIBUTION IN THE EARTH (3) Principles and data from studies of phase equilibria, petrology, and crystal structure as related to distribution of elements in minerals, rocks, and the earth. *Mr. Keith*
515. ELECTRIC WELL-LOGGING (2-3) Prerequisites: Math. 431, Phys. 285.
516. NUCLEAR GEOPHYSICS (3) Natural radioactivity and its measurement, spectroscopy, age determinations, geothermometry, radioactive prospecting and logging.

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in geophysical and geochemical studies are listed under Mineral Sciences in Part II of this bulletin.

GERMAN †

PROFESSOR PHILIP A. SHELLEY, *Head of the Department*

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| 400. | PROSEMINAR IN BIBLIOGRAPHY AND METHODS OF RESEARCH (2) | <i>Mr. Shelley</i> |
| 401. | HISTORY OF THE GERMAN LANGUAGE (3) | <i>Mr. Buffington</i> |
| 421. | GERMAN LITERATURE IN THE 18TH CENTURY (3) | <i>Mr. Buffington</i> |
| 422. | GERMAN LITERATURE IN THE 19TH CENTURY (3) | <i>Miss Adolf</i> |
| 423. | GERMAN LITERATURE OF THE 20TH CENTURY (3) | <i>Mr. Steiner</i> |
| 443. | (C.Lit. 443). LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9) | <i>Mr. Shelley</i> |

‡1G. ELEMENTARY GERMAN FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.

‡2G. ELEMENTARY GERMAN FOR GRADUATE STUDENTS (3) Continuation of Ger. 1G, with opportunity for reading in special fields.

501. GERMAN LANGUAGE SEMINAR (3-9) Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.

515. GERMAN LITERATURE SEMINAR (3-9) Special aspects and characteristics of individual writers and various types and periods of literature.

524. INTENSIVE STUDY OF THE LIFE AND WORKS OF GOETHE (3) Various phases of the poet's life and individual works. *Mr. Buffington*

531. SPECIAL STUDIES IN THE GERMAN LYRIC (3) *Mr. Shelley*

532. SPECIAL STUDIES IN THE GERMAN DRAMA (3) *Miss Adolf*

533. SPECIAL STUDIES IN THE GERMAN SHORT STORY (3) *Mr. Steiner*

534. SPECIAL STUDIES IN THE GERMAN NOVEL (3) *Miss Adolf*

551. MIDDLE HIGH GERMAN (3) Extensive reading of texts; characteristics of the various dialects. *Mr. Buffington*

552. OLD HIGH GERMAN (3) Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A.D. Papers. *Mr. Buffington*

553. GOTHIC (3) Essentials of the grammar; reading of Ulphilas' Bible translation. Suitable also for advanced students in English. Papers. *Miss Adolf*

HEALTH EDUCATION *

Consult PROFESSOR ARTHUR L. HARNETT, JR.

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| 403. | FIRST AID, ATHLETIC CONDITIONING AND TRAINING (3) |
| 405. | RECENT DEVELOPMENTS IN PUBLIC HEALTH EDUCATION (3-6) |

‡ No graduate credit is given for this course.

406. RECENT DEVELOPMENTS IN SCHOOL HEALTH EDUCATION (3)
 407, 407X. ADVANCED PERSONAL AND PUBLIC HEALTH (3)
 411, 411X. PRINCIPLES AND METHODS OF TEACHING SAFETY EDUCATION (3)
 427. HEALTH FACTORS IN THE DEVELOPMENT OF THE ADOLESCENT (3)
 453, 453X. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION (3)
 455S. RELATIONSHIPS OF HEALTH EDUCATION TO THE EXACT SCIENCES (3)
 456. ADVANCED TECHNIQUES IN RURAL SCHOOL HEALTH (3)
 495S. (Ch.Fin. 495S, Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)
 501. HEALTH IMPLICATIONS IN THE GROWTH AND DEVELOPMENT OF SCHOOL CHILDREN (3) Child growth and development emphasis for teachers; medical inspection and examination; preschool program; early habit formations; behavior problems; cooperation of parents, teachers, and children. Prerequisite: Hl.Ed. 215.
 505. ADVANCED TECHNIQUES IN HEALTH EDUCATION (3) Prerequisites: Hl.Ed. 215, 399, Psy. 437.
 572. TESTS AND MEASUREMENTS IN HEALTH EDUCATION (3) Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Ph.Ed. 490, Hl.Ed. 215, 399.

HISTORY†

PROFESSOR PHILIP S. KLEIN, *Head of the Department*

- 405, 405X. HISTORICAL BACKGROUND OF AMERICAN POLITICAL PARTIES, 1607-1900 (3)
Mr. Rayback
 406. HISTORY OF AMERICAN LABOR (3)
Mr. Rayback
 407. THE DIPLOMATIC HISTORY OF THE UNITED STATES (3)
Mr. DeNovo
 418. RENAISSANCE AND REFORMATION (3)
Mr. Green
 419, 419X. RECENT EUROPEAN HISTORY (3)
Mr. Forster
 421, 421X. RECENT AMERICAN HISTORY (3)
Messrs. McNall and Murray
 423. THE FORMATIVE PERIOD OF AMERICAN HISTORY (3)
Messrs. Klein and Colbourn
 429. INTELLECTUAL HISTORY OF THE MIDDLE AGES (2-3)
Mr. Dahmus
 437. THE MIDDLE AGES FROM CONSTANTINE TO THE CRUSADES (3)
Mr. Dahmus
 438. THE MIDDLE AGES FROM THE CRUSADES TO THE RENAISSANCE (3)
Mr. Dahmus
 440. HISTORY OF ENGLAND AND GREAT BRITAIN SINCE 1485 (3)
Mr. Forster
 441. RECENT HISTORY OF GREAT BRITAIN (3)
Mr. Forster
 443. HISTORY OF MODERN RUSSIA (3)
Mr. Thaden
 444. EASTERN EUROPE IN MODERN TIMES (3)
Mr. Thaden
 447. ECONOMIC DEVELOPMENT OF MODERN EUROPE SINCE 1750 (3)
Mr. Pundt
 448. SOCIAL AND CULTURAL HISTORY OF MODERN EUROPE (3)
Mr. Pundt
 450. ECONOMIC DEVELOPMENT OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 451.
Mr. Hermann
 451. SOCIAL AND CULTURAL HISTORY OF COLONIAL AMERICA, 1607-1783 (3) To alternate with Hist. 450.
Mr. Hermann
 452. SOCIAL AND CULTURAL HISTORY OF THE UNITED STATES SINCE 1783 (3)
Mr. Brown
 453. AMERICAN POLITICAL BIOGRAPHY (3)
Mr. Hermann
 454. THE ECONOMIC DEVELOPMENT OF THE UNITED STATES IN THE 19TH CENTURY (3)
Mr. McNall

HISTORY

460. LATIN AMERICA AND THE UNITED STATES (3) *Mr. Gray*
 461. SOCIAL AND CULTURAL HISTORY OF LATIN AMERICA (3) To alternate with Hist. 460. *Mr. Gray*
 499X. FOREIGN STUDY IN HISTORY (2-6)
 501. EUROPEAN HISTORIOGRAPHY (3) *Mr. Pundt*
 502. AMERICAN HISTORIOGRAPHY (3) *Mr. Klein*
 504. MEDIEVAL CIVILIZATION (3-9) *Mr. Dahmus*
 505. THE AGE OF THE REFORMATION (3-9) *Mr. Green*
 508. STUDIES IN EUROPEAN HISTORY, 1600-1789 (3-6) *Mr. Pundt*
 509. EUROPE SINCE 1789 (3-6) Prerequisites: Hist. 18, 19. *Messrs. Pundt and Forster*
 512. STUDIES IN PENNSYLVANIA HISTORY (3-6) *Mr. Klein*
 520. COLONIAL AND REVOLUTIONARY AMERICA (3-6) Prerequisites: Hist. 20, 21. *Mr. Hermann*
 533. THE UNITED STATES, 1783-1860 (3-6) *Mr. Klein*
 534. THE UNITED STATES, 1860-1900 (3-6) Prerequisites: Hist. 20, 21. *Messrs. Hermann and Brown*
 536. THE UNITED STATES IN THE 20TH CENTURY (3-6) *Messrs. McNall and Murray*
 538. DIPLOMATIC HISTORY OF THE UNITED STATES (3) *Messrs. Gray and DeNovo*
 540. STUDIES IN BRITISH HISTORY (3-6) *Mr. Forster*
 550. PROBLEMS IN HISTORY (3-6)
 562. SEMINAR IN LATIN-AMERICAN HISTORY (3-6) Prerequisites: Hist. 22, 23. *Mr. Gray*
 563. STUDIES IN THE HISTORY OF THE CARIBBEAN AREA (3) Prerequisites: Hist. 22, 23. *Mr. Gray*

HOME ART

PROFESSOR CHRISTINE F. SALMON, *Chairman of the Division*

No advanced degree is offered in this field, but a candidate with a major in another field may choose a minor in Home Art upon approval by his major department.

400. SPECIAL PROBLEMS IN HOME FURNISHINGS (3)
 433, 433X. ADVANCED HOME CRAFTS (2-12)
 434. THE ART AND THE CRAFTS IN THE HOMEMAKING PROGRAM (3-6)
 440, 440X. HOME FURNISHING PROBLEMS (3)
 443. HOME ARTS IN THE ADULT PROGRAM (3)
 444, 444X. HOME FURNISHING TEACHING PROBLEMS (3)
 447, 447X. HOME FURNISHINGS FOR THE FAMILY (3)

515. **BACKGROUNDS OF THE HOME ARTS (3)** Evaluation of useful objects in respect to their form, function, and time; selections for exhibition. Prerequisites: H.Art 216 or Art 54 or Art Ed. 6, and Art 74 or H.Art 240.
530. **PROBLEMS IN HOME ART (1-6)** Individual investigation, analysis, and presentation. Prerequisite: 6 credits in home art, art education, or art.
541. **ART IN THE ENVIRONMENT (3)** Approach based upon human needs with consideration of materials in the light of their use in home living. Prerequisite: Art 76 or Art Ed. 5 or H.Art 440.

HOME ECONOMICS EDUCATION †

PROFESSOR JEAN D. AMBERSON, *Head of the Department*

- 406, 406v, 406X, 406vX. **TEACHING AIDS IN FAMILY LIFE EDUCATION (1-4)**
- 427, 427v, 427X, 427vX. **FAMILY LIFE EDUCATION (3)**
- 443, 443v, 443X, 443vX. **ADULT HOMEMAKING EDUCATION (3)**
- 463, 463v. **SENIOR SEMINAR (1)**
- ‡466, 466v. **STUDENT TEACHING (9)**
- 478, 478v, 478X, 478vX. **APPRAISING STUDENT PROGRESS IN EDUCATION FOR FAMILY LIVING (3)**
- 479, 479v, 479X, 479vX. **READINGS IN HOME ECONOMICS EDUCATION (1-4)**
- 502, 502v. **HOME ECONOMICS INSTRUCTION AT THE COLLEGE LEVEL (3)** Teaching techniques suitable for college instruction in home economics; for prospective home economics college teachers not majoring in home economics education.
- 503, 503v. **PROBLEMS IN HOME ECONOMICS TEACHER EDUCATION (3)** Organization of college programs of teacher education; use of resources; records; field services; recruitment and selection of personnel. Prerequisite: at least two years of experience in teaching home economics.
- 504, 504v. **CURRENT DEVELOPMENTS IN EDUCATION IN RELATION TO HOME ECONOMICS (3)** Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics. *Miss Amberson*
- 505, 505v, 505X, 505vX. **PRACTICUM IN TEACHING HOME ECONOMICS IN THE SECONDARY SCHOOL (3-6)** Projects in home economics education which may be carried out in the school in which the teacher is regularly employed. *Miss Hillier*
- 509, 509v, 509X, 509vX. **CURRICULUM WORKSHOP IN FAMILY LIFE EDUCATION (3)** Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics. *Miss Amberson, Hatcher, or Hillier*
- 510, 510v, 510X, 510vX. **THE SUPERVISION OF HOME ECONOMICS TEACHING (2-6)** For teachers of home economics desiring to qualify as city, county, or student teacher supervisors. Prerequisite: graduation from a four-year teacher training curriculum and two years' teaching experience in home economics.

Miss Amberson or Miss Hillier

† A grade point average of 2.2 in all previous work is prerequisite to each course in student teaching.

HOME ECONOMICS EDUCATION

- 518, 518v, 518X, 518vX. EVALUATION IN FAMILY LIFE EDUCATION (3) Methods of evaluating progress toward goals in home economics education and use of findings in program planning and revision. *Miss Amberson, Hatcher, or Hillier*
- 521, 521v, 521X, 521vX. HOME ECONOMICS EDUCATION SEMINAR (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems. *Miss Amberson or Miss Hatcher*
- 526, 526v, 526X, 526vX. THE COMMUNITY PROGRAM IN FAMILY LIFE EDUCATION (2-3) Ways of discovering community needs and resources; methods in developing the community program in family living; leadership education for the lay member of the community.
- 530, 530v. PROBLEMS IN HOME ECONOMICS EDUCATION (1-6 per semester) Individual investigation of problems related to the teaching, supervision, or administration of home economics education.

HOME MANAGEMENT AND FAMILY ECONOMICS †

PROFESSOR DELPHA E. WIESENDANGER

Head of the Department of Home Management, Housing, and Home Art

- 415, 415X. HOUSEHOLD BUYING PRACTICES (3) *Miss Johnston*
- 419, 419X. MANAGING FAMILY FINANCIAL RESOURCES (3) *Mrs. Honey*
- 423, 423X. (Fd.Ntr. 423). FAMILY FOOD PURCHASING (2)
- 424, 424X. ECONOMIC CONDITIONS IN RELATION TO THE FAMILY (3) *Miss Britton*
- 439, 439X. HOME MANAGEMENT (2) *Miss Henderson, Miss Starr, and Mrs. Nolan*
442. RESIDENT EXPERIENCE IN HOME MANAGEMENT (3) Room and board will be charged at regular rates. *Miss Starr*
445. HOME MANAGEMENT EXPERIENCE (3) *Miss Starr*
477. FAMILY MANAGEMENT (3)
- 515, 515X. CONSUMER PROBLEMS (2-3) Methods of securing, evaluating, and presenting data concerning household commodities. For home economics teachers in high schools, colleges, and adult classes. Prerequisites: Fd.Ntr. 220, H.Mgmt. 442. *Miss Johnston*
524. ECONOMIC PROBLEMS OF THE HOUSEHOLD (3) Economic problems of the present-day family; special emphasis on factors in household production, use of money income, and standards of living. Prerequisites: H.Mgmt. 439, Econ. 14. *Misses Johnston and Britton*
528. HOME MANAGEMENT SUPERVISION (2-3) Evaluation of objectives and techniques in organization, supervision, and teaching of the home management house experience. Prerequisite: H.Mgmt. 439.
543. HOME MANAGEMENT IN RELATION TO FAMILY LIVING (3) Includes work with families in solution of their management problems. Prerequisites: Fd.Ntr. 220, H.Mgmt. 439. *Miss Wiesendanger and Mrs. Nolan*
544. PROBLEMS IN HOME MANAGEMENT (3) Specific management problems, such as social, financial, and material, including development of college level teaching aids. Prerequisites: 6 credits of home management or family economics courses in home economics. *Miss Wiesendanger*

HORTICULTURE †

PROFESSOR RUSSELL E. LARSON, *Head of the Department*

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| 412. STORAGE OF HORTICULTURAL CROPS (3) | <i>Mr. Ritter</i> |
| 418. SUBTROPICAL AND TROPICAL FRUITS (3) | <i>Mr. White</i> |
| 420. ADVANCED COMMERCIAL VEGETABLE PRODUCTION (3) | <i>Mr. Odland</i> |
| 423. ADVANCED FRUIT AND VEGETABLE PROCESSING (3) | <i>Mr. Thomas</i> |
| 424. ADVANCED OLERICULTURE (3-6) | <i>Mr. Odland</i> |
| 427. ADVANCED FLORICULTURE (3) | <i>Mr. Seeley</i> |
| 428. ADVANCED FLORICULTURE (3) | <i>Mr. Seeley</i> |
| 434. RECREATION AREAS AND FACILITIES (4) | <i>Mr. Wilson</i> |
| 444. ADVANCED PLANT BREEDING (3-6) | <i>Mr. Walker</i> |
| 445. ADVANCED POMOLOGY (3) | <i>Mr. Tukey</i> |
| 446. ADVANCED POMOLOGY (3) | <i>Mr. White</i> |
| 447. PROBLEMS IN POMOLOGY (1-6) | |
| 453. NURSERY PRINCIPLES AND PRACTICE (3) | <i>Mr. Meahl</i> |
| 454. LANDSCAPE PROBLEMS (3-6) | <i>Mr. Bracken</i> |
| 455. LANDSCAPE PROBLEMS (3-6) | <i>Mr. Bracken</i> |
| 456. PROBLEMS IN NURSERY PRACTICE (3) | <i>Mr. Meahl</i> |
| 460. LANDSCAPE HORTICULTURE PROJECTS (3-6) | <i>Mr. Bracken</i> |
| 461. PARKS AND PARK ADMINISTRATION (3-6) | <i>Mr. Wilson</i> |
| 462. INSTITUTIONAL GROUNDS AND THEIR ADMINISTRATION (3-6) | <i>Mr. Wilson</i> |
| 463. LANDSCAPE HORTICULTURE PROJECTS (1-6) | <i>Mr. Bracken</i> |
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| 500. ECOLOGY OF FRUIT PLANTS (3) Factors limiting the distribution and intensity of culture of fruit species and varieties and effect of environmental factors on cultural practices. | |
| 501. EXPERIMENTAL PROBLEMS IN POMOLOGY (2-12) Investigation of problems involving review of literature, field and laboratory research. Prerequisite or concurrent: Hort. 445. | <i>Mr. White</i> |
| 503. EXPERIMENTAL PLANT BREEDING (2-12) Problems based mainly on research work of the department, with review of experimental methods and literature. Prerequisite: Hort. 444. | <i>Mr. Larson</i> |
| 504. EXPERIMENTAL PROBLEMS IN OLERICULTURE (2-9) Investigation of problems involving review of literature, field and laboratory research. Prerequisite: Hort. 420 or 424. | <i>Mr. Odland</i> |
| 505. PROBLEMS IN VEGETABLE PRODUCTION (2-6) Methods used in the more valuable contributions to vegetable production. Prerequisite: Hort. 420 or 424. | <i>Mr. Odland</i> |
| 506. NUTRITION OF HORTICULTURAL CROPS (2-4) Principles, applications, and interpretations of diagnostic methods for determining fertilizer requirements of horticultural crops. | <i>Mr. Smith</i> |
| 512. PRINCIPLES OF FRUIT AND VEGETABLE STORAGE (2-4) Principles involved in the maturation, storage, and senescence of fruits and vegetables, and their application. | <i>Mr. Ritter</i> |
| 513. EXPERIMENTAL PROBLEMS IN ORNAMENTAL HORTICULTURE (2-12) Review of research in ornamental horticulture, with original investigations. | <i>Mr. Meahl</i> |

HORTICULTURE

514. PROPAGATION OF ORNAMENTAL AND FRUIT PLANTS (3) Factors affecting the asexual and sexual propagation of fruit and ornamental plants. *Mr. Meahl*
517. HORTICULTURE SEMINAR (1 per semester) Review of current research publications in horticulture. Each student presents one or more reviews of assigned topics.
518. ADVANCED PROBLEMS IN LANDSCAPE DESIGN (2-12) Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. *Mr. Bracken*
519. SEMINAR ON THE GENETICS OF HORTICULTURAL CROPS (1 per semester) Review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics.
520. SEMINAR ON THE BREEDING OF HORTICULTURAL CROPS (1 per semester) Each student presents one or more reviews of literature on assigned topics.
521. TECHNICAL PRACTICES IN LANDSCAPE CONTRACTING (2-12) Commercial and technical operations in landscape contracting and maintenance services. Prerequisites: Hort. 460, 461. *Mr. Bracken*
523. PROPAGATION AND IMPROVEMENT OF VEGETABLE AND FLOWER CROPS (3) Methods and special techniques in breeding of flowers and vegetables; maintenance of seed stocks and seed production. Prerequisite: Hort. 444. *Mr. Odland*
524. EXPERIMENTAL PROCEDURES IN HORTICULTURAL RESEARCH (3) *Mr. Larson*
525. HORTICULTURAL RESEARCH TECHNIQUES (3) Practice in and comparison of methods and apparatus used in horticultural research. *Mr. White*
526. EXPERIMENTAL PROBLEMS IN FLORICULTURE (2-12) Greenhouse research and review of literature. Prerequisite or concurrent: Hort. 427, 428. *Mr. Seeley*
527. EXPERIMENTAL PROBLEMS IN NUTRITION OF HORTICULTURAL CROPS (2-12) Review of current research; problems for independent investigation. *Mr. Smith*

INDUSTRIAL EDUCATION

PROFESSOR S. LEWIS LAND, *Head of the Department*

INDUSTRIAL ARTS EDUCATION †

VOCATIONAL INDUSTRIAL EDUCATION †

The master's degree and the doctorate are offered in the two fields above. Courses are designated as Industrial Arts and Industrial Education.

INDUSTRIAL ARTS

- 400, 400X. SHOP MANAGEMENT AND LAYOUT (2-3)
407, 407X. INDUSTRIAL ARTS EDUCATION (2-3)
421, 421X. CURRICULUM MATERIALS IN INDUSTRIAL ARTS (2-3)
470, 470X. PROBLEMS IN SENIOR HIGH SCHOOL INDUSTRIAL ARTS (2-3)

574. HISTORY AND PHILOSOPHY OF INDUSTRIAL ARTS (2-3) Historical developments and concurrent educational philosophies of industrial arts in American education. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.
575. PROBLEMS IN INDUSTRIAL ARTS EDUCATION (2-3) Subject matter, projects, methods of manual and informational teaching, aids and devices, selection of text and reference materials, personnel organization, shop management, problem pupils. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.
576. SUPERVISION AND ADMINISTRATION OF INDUSTRIAL ARTS EDUCATION (2-3) How to organize, supervise, and administer functioning programs of industrial arts; duties of a supervisor and director of industrial arts. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.
577. TESTING IN INDUSTRIAL ARTS (2-3) Construction of informal manipulative and written tests; use of standardized mechanical aptitude and achievement tests; construction and use of rating scales; scoring and grading; interpretation of test results. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.
578. RESEARCH IN INDUSTRIAL ARTS (2-3) Research techniques in industrial arts education.
580. SEMINAR IN INDUSTRIAL ARTS (2-9) Directed intensive study, investigation, or research in selected phases of the program; reports and constructive criticism. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

INDUSTRIAL EDUCATION

- 401v, 401vX. HISTORY OF INDUSTRIAL EDUCATION (2-3)
- 402v, 402vX. SUPERVISION OF VOCATIONAL EDUCATION (2-3)
- 403v, 403vX. SUPERVISED FIELD WORK (1-6)
- 405v, 405vX. CONFERENCE LEADER TRAINING (2-3)
- 408v, 408vX. OCCUPATIONS (2-3)
- 409v, 409vX. TESTS AND MEASUREMENTS (2-3)
- 412v, 412vX. SPECIAL PROBLEMS IN VOCATIONAL EDUCATION (2-4)
- 414v, 414vX. VOCATIONAL EDUCATIONAL GUIDANCE (2-3)
- 415vS, 415vX. PROBLEMS IN CO-ORDINATING VOCATIONAL EDUCATION (2-3)
- 418v, 418vX. PROBLEMS IN AUDIO-VISUAL AIDS IN INDUSTRIAL EDUCATION (2-3)
- 420v, 420vX. OCCUPATIONAL HYGIENE (2-3)
- 425v, 425vX. WORKSHOP IN INDUSTRIAL EDUCATION (1-6)
- 427v, 427vX. ADVANCED COURSE OF STUDY BUILDING (2-3)
- 446vS, 446vX. IMPROVEMENT OF INSTRUCTION IN VOCATIONAL EDUCATION (2-4)
- 450v, 450vX. SHOP LAYOUT AND MANAGEMENT (2-3)
- 458v. EMERGING PROBLEMS IN VOCATIONAL EDUCATION (1-7)
 - Unit A. Federal and State Laws Relating to Vocational Education (1)
 - Unit B. Framework of Federal, State, and Local Administrative Agencies (1)
 - Unit C. Federal, State, and Local Policies and Plans for Vocational Education (1)
 - Unit D. Local Administration of Vocational Education (1)
 - Unit E. Labor Laws and Labor Relations Affecting Education (1)

INDUSTRIAL EDUCATION

- Unit F. Vocational Training for War and Postwar Eras (1)*
Unit G. Problems in Vocational Rehabilitation of the Physically Handicapped (1)
- 460S. PROBLEMS IN VOCATIONAL REHABILITATION OF THE HANDICAPPED (1-6)
Unit A. The Counseling Interview in Vocational Rehabilitation (1-3)
Unit B. Occupational Information and Placement Techniques in Vocational Rehabilitation (1-3)
- 501v. SEMINAR IN VOCATIONAL EDUCATION (1-12) Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators.
- 506v. ADMINISTRATION OF VOCATIONAL EDUCATION (1-6) The job of the local director of industrial education in organizing and developing city and other local programs of industrial education. Prerequisite: 6 credits in industrial education or valid director's certificate, equivalent training and experience.
- 510v. VOCATIONAL EDUCATION FOR ADMINISTRATORS (2-3) Designed for school administrators and supervisors who desire an understanding of practical arts and vocational education. Prerequisite: Ind.Ed. 1v or trade or teaching experience.
- 550v. RESEARCH IN VOCATIONAL EDUCATION (2-3) Research techniques in vocational industrial education.
- 555v. CURRENT PROBLEMS IN VOCATIONAL EDUCATION (1-6) Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome.
Unit A. Changing Industrial, Economic, and Social Conditions (1)
Unit B. Policies and Program of the American Vocational Association (1)
Unit C. Federal and State Vocational Legislation, Present and Pending (1)
Unit D. Financing Vocational Education (1)
Unit E. Current Administrative Problems in Vocational Education (1)
Unit F. Current Administrative Problems in Vocational Education (cont'd) (1)
- 558v. FRONTIER PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (2-3 per unit)
Unit A. Federal Legislation (2-3)
Unit B. Present-Day Local Personnel and Curriculum Problems (2-3)
Unit C. State and Local Supervision and Administration (2-3)
- 560v. PHILOSOPHY OF INDUSTRIAL EDUCATION (2-3) Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices. Prerequisite: 12 credits in industrial education or teaching experience.

INDUSTRIAL ENGINEERING †

PROFESSOR BENJAMIN W. NIEBEL, *Acting Head of the Department*

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| 400. ENGINEERING FOR PRODUCTION (3) | |
| 402, 402X. ENGINEERING ECONOMY (3) | Messrs. Niebel, Roscoe, and Thuerling |
| 404. SCIENTIFIC MANAGEMENT (2) | Messrs. Caldwell and Roscoe |
| 406. FACTORY PLANNING (2) | Messrs. Thuerling and Linsky |

INDUSTRIAL ENGINEERING

- 422a,b,c,d,e,f, 422a,b,c,d,e,fX. INDUSTRIAL ENGINEERING PROBLEMS (2-12)
Messrs. Anderson, Thomas, Niebel, and Thuring
423. QUALITY CONTROL (2) *Messrs. Thuring and Anderson*
424. JOB EVALUATION (3) *Mr. Thomas*
- 425, 425X. METHODS OF INDUSTRIAL OPERATIONS RESEARCH (3)
429. PLASTIC WORKING OF METALS (3) *Mr. Roscoe*
- 430, 430X. INDUSTRIAL LEADERSHIP (3) *Mr. Caldwell*
501. MANUFACTURING METHODS (2-8) Special projects including investigation; experimentation, design, and research of some one or more special types of manufacture. *Mr. Thuring*
502. MANAGEMENT METHODS (3-6) Intensive study of newer phases of scientific management, including production control and application of Gantt charts; research on special problems. *Mr. Thuring*
503. PERSONNEL RELATIONS (2-8) Research on special topics.
505. GRAPHICAL COMPUTATION (2-10) Construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. *Mr. Thuring*
506. TIME AND MOTION STUDY (3-9) Methods of research in motion and time study; critical analysis of current literature. *Mr. Anderson*
507. BUDGETARY CONTROL AND STANDARD COSTS (3-6) Divisional budgets as control media; establishing standard cost data, standard cost accounting procedures, and use of cost variances in controlling manufacturing operations. Prerequisite: I.E. 335.

INSTITUTION ADMINISTRATION *

PROFESSOR ESTHER A. ATKINSON

Head of the Department of Hotel and Institution Administration

The master's degree is offered with a major in Institution Administration. Candidates select courses for the major from hotel administration, institution administration, and related fields.

HOTEL ADMINISTRATION

440. HOTEL OPERATIONAL LIABILITIES (2) *Mr. Bower*
445. HOTEL ORGANIZATION AND OPERATION (3) *Mr. Bower*

INSTITUTION ADMINISTRATION

410. TEA ROOM MANAGEMENT (3)
 437a,b,cS. SCHOOL CAFETERIA PROBLEMS (1-3)
 Unit A. Nutrition and Menu Planning (1)
 Unit B. Equipment (1)
 Unit C. Organization and Management (1)
 438. SCHOOL LUNCH ADMINISTRATION (3)
 461. INSTITUTION ADMINISTRATION (3)
 462. INSTITUTION EXPERIENCE (3)
502. PROBLEMS IN INSTITUTIONAL ADMINISTRATION (3-6) Individual study of problems in institutional administration. Prerequisites: In.Adm. 326, 330.
Miss Atkinson

JOURNALISM *

PROFESSOR DONALD W. DAVIS

Head of the Department of Advertising

PROFESSOR JAMES W. MARKHAM

Head of the Department of News and Editorial Journalism

401. THE PRESS, ITS CRITICS AND ETHICS (3) *Mr. Marbut*
 416. ADVANCED COPY READING (3) *Messrs. Pockrass and Brown*
 424. ADVANCED REPORTING (3) *Mr. Marbut*
 430. SUPERVISION AND MANAGEMENT OF SCHOOL PUBLICATIONS (3)
 441. ADVANCED ADVERTISING COPYWRITING (3) *Mr. Davis*
 466. PUBLICITY AND PUBLIC RELATIONS PROBLEMS (3)
 480. PROBLEMS OF PUBLISHING (3) *Messrs. Markham and Shipman*
504. SEMINAR IN PENNSYLVANIA PRESS HISTORY (3) *Mr. Marbut*
505. INTERNATIONAL PRESS PROBLEMS (3-6) Legal and communications problems of the international flow of news and opinion; international press codes.
Mr. Markham
506. SEMINAR IN COMMUNICATIONS RESEARCH METHODS (3-6) Social science measuring techniques for readership and advertising studies, media effectiveness, and propaganda results.
Mr. Markham
513. CURRENT PROBLEMS IN NEWS REPORTING AND EDITING (3) Securing, writing, display, and treatment of the news; newsroom policies and ethics. *Mr. Marbut*
521. NEWS MEDIA AND PUBLIC OPINION (3) Problems in the function, techniques, and responsibilities of press, radio, and television in forming and interpreting opinion. Prerequisite: Pol.S. 427, Psy. 429, or Soc. 431. *Mr. Markham*
568. SEMINAR IN LEGAL PROBLEMS IN FREEDOM OF THE PRESS (3-6) *Mr. Marbut*

MATHEMATICS †

PROFESSOR ORRIN FRINK, *Head of the Department*

403. MODERN METHODS IN GEOMETRY (3)
404. THEORY OF NUMBERS (3)
405. PARTIAL DIFFERENTIAL EQUATIONS (3)
407. FOUNDATIONS OF ALGEBRA AND GEOMETRY (3)
408. APPLICATIONS OF MATHEMATICS (3)
- 409, 409X-410, 410X. PROBABILITY AND STATISTICS (3 each)
411. FINITE DIFFERENCES (3)
- 412S. ALGEBRAIC EQUATIONS (3)
417. VECTOR ANALYSIS (3)
419. ANALYTICAL MECHANICS (3)
- 420-421. ADVANCED CALCULUS (3 each)
424. LEAST SQUARES (2)
425. CURVE FITTING (1)
431. DIFFERENTIAL EQUATIONS (3)
441. THEORY OF EQUATIONS (3)
- 451-452. INTRODUCTION TO APPLIED MATHEMATICS (3-6 each)
471. FOUNDATIONS OF ALGEBRA (3)
472. FOUNDATIONS OF GEOMETRY (3)
481. VECTORS AND MATRICES (3)

500. ANALYTICAL MECHANICS (3) An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math. 419 or Phys. 461.
- 501-502. THEORY OF FUNCTIONS OF A REAL VARIABLE (3 each) Theory of real functions, sets, measure, derivatives, and integrals. Prerequisite: Math. 420.
503. FOURIER SERIES AND HARMONIC FUNCTIONS (3) Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisites: Math. 90, 420.
505. INTEGRAL EQUATIONS (3) Fredholm and Volterra equations, and applications. Prerequisite: Math. 421.
507. CALCULUS OF VARIATIONS (3) Prerequisites: Math. 90, 421.
- 508-509. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (3 each) Development of the complex number system; theory of analytic functions. Prerequisite: Math. 421.
510. THEORY OF GROUPS (3) General properties of groups with applications. Prerequisite: Math. 471 or 535.
511. LINEAR ALGEBRA AND MATRIX THEORY (3) Vector spaces and linear transformations, canonical representations, elementary divisors and invariant factors. Prerequisite: Math. 481.
- 513-514. ADVANCED ANALYTIC GEOMETRY (3 each) Introduction of homogeneous coordinates and their use in the study of projective properties. Prerequisite: Math. 43.
- 520-521. PROJECTIVE GEOMETRY (3 each) General study of the subject from the postulational standpoint. Prerequisite: Math. 43. Alternate years or as required.

MATHEMATICS

- 522-523. METRIC DIFFERENTIAL GEOMETRY (3 each) The usual classical treatment of the subject. Prerequisite: Math. 43.
- 530-531. TOPOLOGY (3 each) Topological spaces, combinatorial topology, applications to algebra and analysis.
534. THEORY OF ALGEBRAIC NUMBERS (3) Introduction to the number theory of quadratic fields, with study of the theory of ideals in quadratic and higher fields, with application. Prerequisites: Math. 404, 471.
- 535-536. MODERN ALGEBRAIC THEORIES (3 each) Groups, rings, ideals, algebraic number fields, Galois theory. Prerequisite: Math. 471.
- 542-543. THEORY OF STATISTICS (3 each) Univariate and multivariate distributions, sampling distributions, theory of estimation, statistical hypotheses. Prerequisites: Math. 409, 421.
- 550-551. MATHEMATICAL LOGIC (3 each) The logical basis of mathematics and its ultimate nature. Prerequisite: Math. 471 or Phil. 428.
- 552-553. NUMERICAL METHODS (3 each) Procedures for practical calculation, including interpolation, solution of equations, iterative methods, harmonic analysis and use of modern calculating equipment. Prerequisite: Math. 420.
- 560-561. THEORY OF DIFFERENTIAL EQUATIONS (3 each) Prerequisites: Math. 90, 421.
570. SPECIAL TOPICS IN GEOMETRY (3-6)
571. SPECIAL TOPICS IN ANALYSIS (3-6)
572. SPECIAL TOPICS IN ALGEBRA (3-6)
573. SPECIAL TOPICS IN APPLIED MATHEMATICS (3-6)
574. SPECIAL TOPICS IN FOUNDATIONS OF MATHEMATICS (3-6)
- 575-576. MATHEMATICS SEMINAR (1-6 each) Selected topics from recent mathematical developments.

MECHANICAL ENGINEERING †

PROFESSOR NORMAN R. SPARKS, *Head of the Department*

- 401a,b,c,d. MECHANICAL ENGINEERING (3-12)
402. AIR CONDITIONING (3)
408. STEAM TURBINES (3)
409. GAS TURBINES (3)
410. STEAM POWER PLANTS (3)
- 411, 411X. REFRIGERATION (3)
- 412, 412X. FUNDAMENTALS OF HEAT TRANSFER (3)
413. INTERNAL COMBUSTION ENGINES (3)
416. RESISTANCE AND POWERING OF SHIPS (3)
417. THEORY OF ENGINEERING INSTRUMENTS (3)
450. DESIGN OF MACHINE TOOLS (3)
451. ADVANCED MACHINE DESIGN PROBLEMS (3)

452. MACHINE DESIGN ANALYSIS (3)
 453. BEARING DESIGN AND LUBRICATION (3)
 455. AUTOMATIC CONTROL SYSTEMS (3)
 457. ADVANCED MECHANISMS (3)
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502. ADVANCED GAS TURBINES (3-6) Thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.
 504. ADVANCED ENGINEERING THERMODYNAMICS (3-6) Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisites: M.E. 31, 32.
 505. HEAT TRANSMISSION (3-6) Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412.
 506. MECHANICAL ENGINEERING SEMINAR (1-4) Advanced courses adapted to the individual requirements of graduates in mechanical engineering.
 507. ADVANCED INTERNAL COMBUSTION ENGINES (3) Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504.
 510. FUEL INJECTION AND COMBUSTION IN DIESEL ENGINES (3-6) Characteristics and efficiency of various injection systems.
 511. FUEL SPRAY LABORATORY (3) Laboratory study of fuel injection for the Diesel engine.
 512. SCAVENGING OF TWO-STROKE CYCLE ENGINES (3) Design of ports, valves, blowers, intake and exhaust manifolds for proper scavenging and charging of engines, particularly two-stroke cycle Diesel engines; experimental technique in evaluating scavenging. Prerequisite: M.E. 413.
 513. FUEL FEEDING DEVICES FOR INTERNAL COMBUSTION ENGINES (3) Carburetors and injection equipment for Otto and Diesel engines and for liquid-fuel turbines, including the required control devices.
 552. ADVANCED DYNAMICS OF MACHINES (3-6) Linear and torsional vibrations in and balancing of rotating and reciprocating machinery; exact analysis of stresses produced by these and other dynamic forces in machine parts. Prerequisites: Mchs. 12, M.E. 54.
 553. FRICTION AND LUBRICATION (3) The hydrodynamic theory of lubrication and methods of applying it to bearing design, together with a survey of methods of testing lubricants.
 555. AUTOMATIC CONTROL SYSTEMS (3) Advanced problems and techniques in the design of automatic control systems with emphasis on stability, controller design, and optimum performance. Prerequisite: M.E. 455.
 557. MECHANISM SYNTHESIS (3) Design and analysis of mechanisms for specific motion and energy requirements; intermittent mechanisms. Prerequisite: M.E. 457.
 580. INVESTIGATION PROJECTS (2-6) Special experimental studies or investigations in mechanical engineering, adapted to individual requirements.

METALLURGY †

PROFESSOR AMOS J. SHALER, *Head of the Department*

405. FERROUS METALLOGRAPHY (3)
 406. NONFERROUS METALLOGRAPHY (3)
 407. METALLURGICAL ENGINEERING I (3)
 408. METALLURGICAL ENGINEERING II (3)
 409. METALLURGICAL INVESTIGATIONS I (3)
 410. METALLURGICAL INVESTIGATIONS II (3)
 411. ADVANCED PHYSICAL METALLURGY (3)
 412. EXPERIMENTAL METALLURGY (3)
 413. ADVANCED CHEMICAL METALLURGY (3)
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501. METALLURGICAL PROBLEMS (1-6 per semester) Independent study of special problems in metallurgy. Prerequisites: Met. 411, 413.
 502. SEMINAR IN METALLURGY (1-6) Conferences, reading, reports, and special lectures. *Mr. Shaler*
 515. CORROSION OF METALS (3) Phenomena and theories of metallic corrosion; principles of alloy selection for engineering and structural uses in corrosive environments. Prerequisites: Met. 411, 413. *Mr. Read*
 516. FLOW AND FRACTURE OF SOLIDS (3) Phenomenological and theoretical treatment of flow and fracture in solids. *Mr. Shaler*
 518. CONSTITUTION OF METALLURGICAL SYSTEMS (3) Application of thermodynamic principles to study of heterogeneous equilibrium in alloy, slag, and slag-metal systems. Prerequisites: Met. 411, 413. *Mr. Davis*
 519. ADVANCED FERROUS METALLURGY (3) Physicochemical principles in the smelting and refining of iron and steel; slag control; solidification and primary forging of steel. Prerequisites: Met. 411, 413. *Mr. Davis*
 520. FOUNDRY METALLURGY (3) Principles of foundry metallurgy; application to foundry operations for various ferrous and nonferrous casting alloys. Prerequisites: Met. 411, 413. *Mr. Lindsay*
 522. SOLID PHASE REACTIONS IN METALS (3) Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitations from solid solution, eutectoid decomposition and order-disorder phenomena. Prerequisites: Met. 411, 413. *Mr. Lindsay*
 524. ADVANCED METAL WORKING (3) Elements of mathematical theory of plasticity; metal working processes; measurement of deformations in metal working; theory of metal working. Prerequisite: Met. 516. *Mr. Shaler*
 525. METAL FINISHING (3) Metallic coatings and their metallurgical properties; theories and problems of application, utilization, and evaluation. Prerequisites: Met. 411, 413. *Mr. Read*

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in metallurgical studies are listed under Mineral Sciences in Part II of this bulletin.

METEOROLOGY †

PROFESSOR HANS NEUBERGER, *Head of the Department*

411. SYNOPTIC METEOROLOGY I (3)
 412. SYNOPTIC METEOROLOGY II (3)
 418. INTRODUCTORY PHYSICS OF THE UPPER ATMOSPHERE (3)
 431. SYNOPTIC METEOROLOGY LABORATORY I (3)
 432. SYNOPTIC METEOROLOGY LABORATORY II (2-10)
 433. ADVANCED SYNOPTIC ANALYTICAL TECHNIQUES (3)
 443. PHYSICAL METEOROLOGY (3)
 445. HYDROMETEOROLOGY (3)
 450. APPLICATIONS OF STATISTICS TO METEOROLOGY (3)
 451. DYNAMIC METEOROLOGY I (3)
 452. DYNAMIC METEOROLOGY II (3)
 461. THEORY OF METEOROLOGICAL INSTRUMENTS (3)
 472. PHYSICAL AND DYNAMIC CLIMATOLOGY (3)
 492. METEOROLOGICAL SEMINAR (2)
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500. METEOROLOGICAL SEMINAR (1-3) Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteo. 412, 451.
 502. SELECTED TOPICS OF ADVANCED METEOROLOGY (2) Current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology.
 503. ATMOSPHERIC TURBULENCE (3) Atmospheric diffusion, heat conduction, friction, and evaporation; statistical properties of turbulence.
 504. ADVANCED DYNAMIC METEOROLOGY (3) Introduction to perturbation theory with application to gravitational and long waves; principles of dynamic-numerical forecast methods. Prerequisite: Meteo. 452.
 505. BIOCLIMATOLOGY (2) Climatic phenomena in their relation to life. Prerequisite: Meteo. 472.
 506. ADVANCED METEOROLOGICAL ANALYSIS (2-6) Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteo. 412.
 507. DYNAMIC OCEANOGRAPHY (2) Physical properties of sea water; heat balance of the oceans; theory and observations of ocean currents, waves, and tides.
 508. PHYSICS OF THE UPPER ATMOSPHERE (2) Temperature distribution, composition, and electrical characteristics of the upper atmosphere; theories of aurora and light of the night sky.
 509. THEORETICAL CLIMATOLOGY (2) Theory of latitudinal, annual, and diurnal temperature changes; theories of climatic changes; microclimate.
 510. CLOUD PHYSICS (2) Current theories on phase changes in clouds and mechanisms responsible for precipitation; techniques of cloud modification and control.

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in meteorological studies are listed under Mineral Sciences in Part II of this bulletin.*

MINERAL ECONOMICS †

PROFESSOR JOHN D. RIDGE, *Head of the Department*

- 400. SEMINAR (1)
- 453. NONMETALLIC MINERALS (3)
- 463. MINERAL ECONOMY OF THE U.S.S.R. (3)
- 483. THE METALS AND THEIR ORES (3)
- 484. THE SOLID FUELS (3)
- 486. PETROLEUM AND NATURAL GAS ECONOMICS (3)
- 490. MINERAL VALUATION (3)
- 491. ANALYSIS OF MINERAL DATA (2)

- 500. ADVANCED PRINCIPLES OF MINERAL ECONOMICS (3-6) Economic history of mineral industries, research methods, economics of mineral exploitation and utilization, mineral policy.
- 501. RESEARCH IN MINERAL ECONOMICS (3-6) Investigation in specialized fields of research in mineral economics. Prerequisite: 3 credits in Min.Ec. 500.
- 502. TECHNOLOGIC INFLUENCES (3-9) Relationship of technologic advancements to economic development of the mineral industries. Prerequisite: 3 credits in Min.Ec. 500.
- 505. PROBLEMS OF MINERAL ECONOMICS (3-12) Determination of basic technologic-economic patterns of selected mineral industries. Prerequisite: 3 credits in Min.Ec. 500.

MINERAL PREPARATION †

PROFESSOR H. BEECHER CHARMBURY, *Head of the Department*

- 400. MINERAL PREPARATION SEMINAR (1)
- 403. FLOWSHEETS OF MINERAL PREPARATION PLANTS (2)
- 404. PLANT LAYOUT AND DESIGN (3)
- 405. UNIT OPERATIONS (3)
- 406. MINERAL PREPARATION TESTING (2)
- 410. COAL PREPARATION (3)

- 502. FROTH FLOTATION AND AGGLOMERATION (3) Intensive study of theory and applications of froth flotation and agglomeration. Prerequisite: Min.Pr. 405. *Mr. Sun*
- 504. MINERAL PREPARATION RESEARCH (3-10) Research work on specific problems in mineral preparation. Prerequisite: Min.Pr. 405 or 410. *Mr. Charmbury and Staff*
- 505. GRAVITY PROCESSES AND MISCELLANEOUS METHODS OF MINERAL PREPARATION (3) Intensive study of theory and applications of gravity, magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Min.Pr. 405. *Mr. Mitchell*

MINERAL PREPARATION

506. MINERAL PREPARATION PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Min.Pr. 405. *Mr. Mitchell*

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in mineral preparation studies are listed under Mineral Sciences in Part II of this bulletin.*

MINERALOGY †

PROFESSOR JOHN C. GRIFFITHS, *Head of the Department*

460. OPTICAL MINERALOGY (3) *Mr. Wright*
483. PETROGRAPHY (4)

500. PHYSICAL MINERALOGY (3) Optical methods and measurement of optical constants of minerals. *Mr. Wright*

- 501a. PETROLOGY (3-6) Microscopic study of rocks, emphasizing classification and genetic relationships. *Messrs. Krynine, Tuttle, and Griffiths*

- ‡ 502. MINERALOGICAL PROBLEMS (3-18) Original study of some mineralogical problem, results of which may be applied on the thesis requirements.

504. THEORETICAL MINERALOGY (2) Crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena. *Mr. Bates*

505. MINERALOGY SEMINAR (1-2) Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students. *Messrs. Krynine, Tuttle, Bates, Griffiths, and Brindley*

- § 510. METAMORPHIC PETROLOGY (2-6) Detailed review of chemical, mineralogical, and structural changes that take place during metamorphism. Prerequisite: Min. 483. *Mr. Krynine*

511. SEDIMENTARY PETROLOGY (3-4) Composition, texture, structure, mass properties of sediments; dynamic processes in complex natural systems; sedimentary stages: weathering, erosion, transport, deposition, and lithification. Prerequisite: Min. 483. Concurrent: Min. 513. *Mr. Krynine*

512. SEDIMENTARY PETROLOGY, CONTINUED (2-4) Diastrophism and tectonic background of sedimentation; depositional loci; classification of sediments: quartzites, graywackes, arkoses; chemical sediments; paleogeography, paleoclimatology, oil finding. Prerequisite: Min. 511. Concurrent: Min. 514. *Mr. Krynine*

513. METHODS OF ANALYSIS OF SEDIMENTS (2) Principles and practices used in analyzing sedimentary rocks for size, shape, and accessory (heavy) minerals. Concurrent: Min. 511. *Mr. Griffiths*

‡ Credits to be arranged, 3-9 per semester.

§ Credits to be arranged, 2-4 per semester.

MINERALOGY

514. APPLIED SEDIMENTOLOGY (3) Design and control in analysis of sedimentary rocks; application of these techniques to industrial problems. Concurrent: Min. 512. *Mr. Griffiths*
516. PETROLOGY OF FINE-GRAINED SEDIMENTS (2-3) Fine-grained sedimentary rocks and their industrial applications. Prerequisite: Min. 530. *Mr. Griffiths*
- ¶ 517. EUROPEAN SEDIMENTS (1-6) Interpretative microscopic and hand specimen study of selected rock suites from Europe and Asia; correlation with paleogeographic and tectonic data. Prerequisites: Min. 512, 514. *Mr. Krynine*
- § 518. AMERICAN SEDIMENTS (2-8) Thin section, heavy residue, textural and field data of arkoses, graywackes, quartzites, and carbonates from representative North American sedimentary provinces. Prerequisites: Min. 512, 514, 516. *Mr. Krynine*
- || 519. OIL RESERVOIR PETROLOGY (2-6) Petrographic fundamentals controlling porosity, storage capacity, oil accumulation, effective permeability, fluid yield and retention, exploration and production methods. Prerequisites: Min. 512, 514, 516. *Messrs. Krynine and Griffiths*
520. STUDY OF ACCESSORY MINERALS (2-4) Detailed study of accessory (heavy) minerals; their significance in problems of provenance, petrogenesis, mineral stratigraphy, and paleogeography. Prerequisites: Min. 511, 512, 513, 514. *Mr. Griffiths*
521. COLOR IN MINERALS (1-2) Nature of light absorption as a function of chemical composition for solutions, glasses, and minerals. *Mr. Weyl*
- || 523. X-RAY DIFFRACTION STUDIES OF MINERALS (2-6) Investigation of mineralogical problems with X-rays. Practicum includes preparation of samples, use of X-ray apparatus, and interpretation of patterns. *Mr. Brindley*
524. INTRODUCTION TO SEDIMENTATION (3) Concurrent: Min. 483. *Mr. Krynine*
525. IGNEOUS PETROLOGY (2-6) Origin, distribution, and composition of igneous rocks. Prerequisite: Min. 483. *Mr. Tuttle*
530. (Cer.T. 530). STRUCTURE, PROPERTIES, AND OCCURRENCE OF CLAY MINERALS (2-5) Structure analysis and identification of clay minerals; mineral transformations and behavior; occurrence, genesis, and petrography of fine-grained sediments. *Messrs. Griffiths, Bates, and Brindley*
- NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in mineralogical studies are listed under Mineral Sciences in Part II of this bulletin.

MINING †

PROFESSOR ARNOLD W. ASMAN, *Head of the Department*

400. MINE SAFETY ENGINEERING (2)
471. MINE MECHANIZATION (3)

† Credits to be arranged, 1-3 per semester.
§ Credits to be arranged, 2-4 per semester.
|| Credits to be arranged, 2-3 per semester.

- 472. MINING DESIGN (3)
- 481. MINE VENTILATION (4)
- 484. MINE COST CONTROL (2)
- 488. ADVANCED MINE MECHANIZATION (3)
- 494. MINE MANAGEMENT ENGINEERING (3)
- 499. MINE PRODUCTION CONTROL (2)

- 500. MINING SEMINAR (2) Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering.
- 501. MINE ENGINEERING (3) Mine mechanization problems. Selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488.
- 504. MINING RESEARCH (3-10 per semester) Research work on specific problems in physics of mining and mine mechanization. Prerequisite: Mng. 481.
- 506. MINE AND MINE PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499.
- 520. MINE PLANNING USING CYCLE STUDIES (3-6) Highly productive cycles of mine section operation are developed by use of time and method studies of the various sub-cycles involved. Prerequisite: Mng. 472.
- 521. MATHEMATICAL ANALYSIS OF MINE LAYOUTS (3) Proportioning layouts in regard to mineral available, distances, and centroids of mining areas; incremental and sub-cycle costs. Prerequisite: Mng. 488.
- 522. ROCK MECHANICS (3-6) Detailed study of the physical properties of rocks as affecting the design of underground openings; testing procedures, calculations, and design. Prerequisite: Mng. 499.
- 523. MINE DUSTS (3) Detailed studies of methods of collecting, sampling, and determining amount, size, and mineral content of dust in mine atmospheres; methods of dust control. Prerequisite: Mng. 481.
- 524. UNDERGROUND MINING POWER DISTRIBUTION SYSTEMS (3-6) Calculations involved in the design of power applications and systems for mines; electrical, compressed air; Diesels; package power for extremely gassy conditions; sectionalizing; loads and load centers. Prerequisite: Mng. 488.

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in mining studies are listed under Mineral Sciences in Part II of this bulletin.*

MUSIC *

PROFESSOR HUMMEL FISHBURN, *Head of the Department*

- 407. PIANO REPERTOIRE (3)
- 408. VOCAL LITERATURE (3)
- 410. MUSIC OF THE 20TH CENTURY (3)
- 411. LITERATURE OF THE VIOLIN (3)
- 429-432. SINGER'S STYLE AND INTERPRETATION (3 per course) Fee \$25 per course.

MUSIC

456. ELEMENTARY COUNTERPOINT (3)
459. MODERN INSTRUMENTAL ARRANGING (3)
466. ADVANCED CONDUCTING (3)
- 503-506. ADVANCED STRINGED INSTRUMENTS (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 103-106. Fee \$25 per course.
- 511-514. ADVANCED PIANO (3 per course) Piano literature of all periods; stress laid on developing technique and preparing for public performance. Fee \$25 per course.
- 531-534. ADVANCED ORGAN (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 31-34. Fee \$30 per course.
543. MODERN HARMONY (3) Harmonic writing based on 20th century practices with attention to traditional idioms that serve as foundation.
557. SYMPHONIC STRUCTURE (3) Survey of the evolution and application of the forms used in symphony, sonata, concerto, string quartet, and related works. Prerequisite: Music 57.
- 558-561. FREE COMPOSITION (3 per course) Composition: vocal and instrumental, standard or modern idioms. Prerequisite: 18 credits in harmony, counterpoint, and piano.
563. FREE ARRANGING (3) Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisite: 18 credits in harmony, including 3 of orchestration.
567. THE LITERATURE OF THE ORCHESTRA (3) The suite, symphony, tone poem, and overture from the point of view of appreciation, form, and orchestration. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra.

MUSIC EDUCATION †

PROFESSOR HUMMEL FISHBURN, *Head of the Department*

401. MUSIC IN THE RURAL AREA (3)
462. PEDAGOGY OF THEORY (3)
468. THE TEACHING OF PIANO (3)
469. BAND AND ORCHESTRA TECHNIQUE (3)
470. CHORAL TECHNIQUE (3)
475, 475X. OBJECTIVES AND PROBLEMS IN ELEMENTARY MUSIC EDUCATION (3)
500. MUSIC EDUCATION SEMINAR (3-6) Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems.
569. PRESENT-DAY TRENDS IN INSTRUMENTAL MUSIC (3) New methods and materials for band, orchestra, and ensembles.

571. VOCAL PEDAGOGY (3) Detailed study of vocal problems met in public schools, elementary through high school; vocal class pedagogy and literature; daily voice training. Prerequisites: Mus.Ed. 48, teaching experience.
572. INSTRUMENTAL PEDAGOGY (3-6) Research problems in band and orchestra. Prerequisite: Mus.Ed. 54 or practical experience.
573. THE MATERIALS OF APPRECIATION (3) Methods and materials for development of music appreciation in elementary and secondary schools. Prerequisites: Music 5, teaching experience.
- 574a,b. PRESENT-DAY TRENDS IN MUSIC EDUCATION (3-6) Present-day music education materials and methods (elementary and secondary levels) in relation to modern educational philosophy; emphasis upon practical problems presented by members of the class. Prerequisites: Mus.Ed. 48, teaching experience.
575. THE JUNIOR HIGH SCHOOL MUSIC CURRICULUM (3) Instructional materials, procedures, curricular and extracurricular activities, integration with other subjects.
576. MUSIC SUPERVISION (3) Current educational procedures in training music supervisors.
580. FIELD PROJECTS IN JUNIOR AND SENIOR HIGH SCHOOL MUSIC (3) Curricular problems to be carried on under actual school conditions; individual work under supervision. Prerequisites: teaching experience, 30 credits of graduate study.
594. PEDAGOGY OF EAR TRAINING (3) Materials and methods for training the listener to grasp, understand, and write what is heard from melody to four-part harmony. Prerequisite: 12 credits in ear training and/or harmony.

PETROLEUM AND NATURAL GAS ENGINEERING †

PROFESSOR RALPH F. NEILSEN

Acting Head of the Department of Petroleum and Natural Gas

The Master of Science and Doctor of Philosophy degrees are offered with a major in Petroleum and Natural Gas Engineering, but courses are designated simply as Petroleum and Natural Gas.

PETROLEUM AND NATURAL GAS

420. EXPLOITATION AND DEVELOPMENT ENGINEERING (3)
481. NATURAL GAS AND GASOLINE PLANTS (3)
483. NATURAL GAS LABORATORY (1)
485. SECONDARY RECOVERY (3)
490. ADVANCED CORE TESTING (3)
500. PETROLEUM AND NATURAL GAS ENGINEERING PROBLEMS (3-9 per semester)
501. ENERGETICS OF PETROLEUM ENGINEERING (3) Applications of thermodynamics to special problems in production of petroleum and natural gas.

PETROLEUM AND NATURAL GAS ENGINEERING

502. PETROLEUM AND NATURAL GAS ENGINEERING SEMINAR (3-9) Intensive study of one or several phases of petroleum engineering.
503. THE FLOW OF HOMOGENEOUS FLUIDS THROUGH POROUS MEDIA (3) Flow and pressure distributions for various geometric patterns for steady and unsteady states. Prerequisite: Math. 431.
504. WATER FLOODING (3-6) Continuation of Pet.E. 485 with emphasis on special problems. Prerequisite: Chem. 460.
506. ADVANCED PETROLEUM ENGINEERING (5) Advanced problems in petroleum and natural gas production. Prerequisites: Chem. 461, Pet.E. 310.
507. CONDENSATE FIELDS (2) Retrograde condensation phenomenon of hydrocarbon mixtures at high pressures; literature on condensate fields; production methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: Pet.E. 501.
508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Principles of colloidal activity applied to control of properties of clay slips, drilling fluids, and similar suspensions. (In co-operation with the Ceramic Technology staff.) Prerequisite: Chem. 461.
509. ADVANCED PETROLEUM ENGINEERING DESIGN (2) Continuation of Pet.E. 320. Projects in selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: Pet.E. 320.

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in petroleum and natural gas studies are listed under Mineral Sciences in Part II of this bulletin.*

PHILOSOPHY *

PROFESSOR ERNEST H. FREUND, *Head of the Department*

401. RELIGIOUS PHILOSOPHY OF THE GREAT REFORMERS (3)
- 404X. ADVANCED HISTORY OF PHILOSOPHY (3)
406. MEDIEVAL PHILOSOPHY (3)
414. AESTHETIC THEORY (3)
415. THE PHILOSOPHY OF KANT (3)
418. RECENT AND CONTEMPORARY PHILOSOPHY (3)
419. PHILOSOPHICAL BACKGROUNDS OF AMERICAN THOUGHT (3)
425. PHILOSOPHY OF LAW (3)
426. METAPHYSICS (3)
427. ADVANCED ETHICS (3)
428. ADVANCED LOGIC (3)
429. SEMANTICS: PHILOSOPHY OF LANGUAGE AND SYMBOLISM (3)
430. PHILOSOPHICAL PROBLEMS (3-6)
450. TYPES OF PHILOSOPHY (3)
- 500a,b. ETHICAL SEMINAR (2-6) Critical study of some phase of ethical fact and theory.

- 501a,b,c,d. PHILOSOPHY SEMINAR (2-12) Meets the demand for advanced study in special fields of philosophical thought.
503. LOGIC (3) The logical basis of mathematics and its ultimate nature.
504. SOCIAL AND POLITICAL PHILOSOPHY (3) Critical study of basic problems in their historical and functional setting.
505. IDEALS OF WESTERN CIVILIZATION (3) Analysis of contemporary ideals in terms of their Graeco-Judean bases.
507. SEMINAR IN HISTORY OF WESTERN PHILOSOPHY (3-12)
510. CLASSICS OF SCIENTIFIC METHOD (3) Actual reasoning and procedures of historical masters of scientific methods.
511. PRINCIPLES OF EXPERIMENTAL INFERENCE (3) Science as controlled inquiry; types of scientific procedures in formal, physical, and sociocultural science.

PHYSICAL EDUCATION †

PROFESSOR JOHN D. LAWTHER

Assistant Dean of the College of Physical Education and Athletics

424. MODERN TRENDS IN HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION EDUCATION, AND ATHLETICS (3)
- 429S. THE MODERN DANCE IN EDUCATION (3)
- 431S. COACHING OF ADVANCED BASEBALL (3)
- 436S. COACHING OF ADVANCED FOOTBALL (3)
- 437S. COACHING OF ADVANCED BASKETBALL (3)
- 438S. COACHING OF ADVANCED TRACK (3)
- 439S. COACHING OF ADVANCED SOCCER (3)
- 440S. COACHING OF ADVANCED GYMNASTICS (3)
- 441S. ADVANCED COACHING OF ATHLETICS FOR MEN (1-11)
- Unit A. Basketball (1)
- Unit B. Football (1)
- Unit C. Track and Field (1)
- Unit D. Baseball (1)
- Unit E. Wrestling (1)
- Unit F. Soccer (1)
- Unit G. Swimming (1)
- Unit H. Gymnastics (1)
- Unit I. Boxing (1)
- Unit J. Lacrosse (1)
- Unit K. Fencing (1)
- 449S. ADVANCED TEACHING OF SPORTS AND RHYTHMICS (1-11)
- Unit A. Soccer and Speedball (1)
- Unit B. Basketball (1)
- Unit C. Field Hockey (1)
- Unit D. Archery (1)
- Unit E. Swimming (1)
- Unit F. Rhythmics for Children (1)

PHYSICAL EDUCATION

Unit G. Modern Dance and Accompaniment (1)

Unit H. Early American Country Dancing and Social Dancing (1)

Unit I. Tennis (1)

Unit J. Badminton (1)

Unit K. Golf (1)

452S, 452X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE ELEMENTARY SCHOOL (3)

453S, 453X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE HIGH SCHOOL (3)

454. THE NATURAL PROGRAM OF PHYSICAL EDUCATION ACTIVITIES, APPLIED (3)

455. SCIENTIFIC METHOD IN HEALTH EDUCATION AND PHYSICAL EDUCATION (3)

460. METHODS AND PRINCIPLES OF ATHLETIC COACHING (3)

466S. VISUAL INSTRUCTION IN ATHLETICS (3)

471S. HEALTH EDUCATION, PHYSICAL EDUCATION, RECREATION EDUCATION, AND ATHLETICS FOR THE SCHOOL ADMINISTRATOR (3)

Unit A. Athletics in the Schools (1)

Unit B. Health Education in the Schools (1)

Unit C. Physical Education and Recreation Education in the Schools (1)

480. ADVANCED ANATOMY AND PHYSIOLOGY, APPLIED (3)

482, 482X. POSTURE EDUCATION IN THE SCHOOLS (3)

488S. THE ADMINISTRATION OF PHYSICAL EDUCATION AND ATHLETICS FOR WOMEN (3)

489. INTRAMURAL ATHLETICS (3)

490. INTRODUCTION TO TESTS AND MEASUREMENTS IN HEALTH EDUCATION AND PHYSICAL EDUCATION (3)

491. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION AND PHYSICAL EDUCATION IN SCHOOLS (3)

500. PROBLEM IN PHYSICAL EDUCATION (3) Prerequisite: Ph.Ed. 455.

522. ORGANIZATION AND ADMINISTRATION OF PHYSICAL EDUCATION IN COLLEGES AND UNIVERSITIES (3) Administration of physical education in college; credits, schedules, excuses, records, reports, budgets, classification, tests, staff, and facilities. Prerequisite: Ph.Ed. 491.

523. ADMINISTRATION OF COLLEGE ATHLETICS (3) Eligibility, schedules, managerial systems, relationships of athletics to the physical education program and to education in general. Prerequisite: Ph.Ed. 491.

526. ATHLETIC PROBLEMS IN SCHOOLS (3) Practical problems which result from administration of athletics in schools. Reports on some aspects of athletics required. Prerequisite: Ph.Ed. 460.

528. PROFESSIONAL EDUCATION OF TEACHERS OF HEALTH EDUCATION AND PHYSICAL EDUCATION (3) Health education and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems. Prerequisite: Ph.Ed. 491.

529. SUPERVISION OF PHYSICAL EDUCATION IN SCHOOLS (3) Methods and policies of the school supervisor of physical education; conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher. Prerequisite: Ph.Ed. 491.

PHYSICAL EDUCATION

530. RESEARCH TECHNIQUES IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION EDUCATION (3) Prerequisite: Ph.Ed. 490.
531. RESEARCH IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION EDUCATION (3) Prerequisite: Ph.Ed. 530.
532. TESTS AND MEASUREMENTS IN PHYSICAL EDUCATION (3) Critical study of tests and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Ph.Ed. 490.
534. STUDIES IN CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION (3) Principles and methods of curriculum building in physical education; different psychological and educational points of view, organizing a course of study committee, making units of instruction. Prerequisite: Ph.Ed. 454.
535. MODERN FOREIGN SYSTEMS OF PHYSICAL EDUCATION (3) Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Ph.Ed. 534, 595.
536. SCIENTIFIC METHODS IN ATHLETIC COACHING (3) Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Ph.Ed. 460.
550. SEMINAR IN HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION EDUCATION (1-6) Open only to students preparing approved theses.
555. RELATIONSHIPS OF PHYSICAL EDUCATION TO THE EXACT SCIENCES (3)
560. ADMINISTRATIVE PROBLEMS OF PHYSICAL EDUCATION IN SCHOOLS (3) Solutions to problems emerging from the administration of physical education in schools, fitting physical education into the school's schedule, awards and budgets. Prerequisite: Ph.Ed. 491.
581. PROBLEMS IN BODY MECHANICS (3) Certain aspects of human motion and body segmental alignment; analysis of human gait, and the dynamic adaptation of the spine, thorax, and pelvis to external physical forces. Prerequisite: Hl.Ed. 244, Ph.Ed. 399.
595. PHILOSOPHY OF HEALTH EDUCATION, PHYSICAL EDUCATION, AND RECREATION EDUCATION (3) Prerequisite: Hl.Ed. 453 or Ph.Ed. 491 or Rec.Ed. 465.

PHYSICAL SCIENCE *

Consult PROFESSOR HENRY W. KNERR

The Master of Education degree is offered with a major in Physical Science. The program, which is designed to meet the needs of secondary school science teachers, consists of at least 24 credits chosen from chemistry, geology, mathematics, and physics and a minor of at least 6 credits in basic education. A candidate is expected to complete at least one course in each of the four sciences and at least 12 credits in one of them. Appropriate courses are regularly offered in the summer, but are rarely available during the academic year.

PHYSICS †

PROFESSOR JOHN A. SAUER, *Head of the Department*

- 400. INTERMEDIATE ELECTRICITY AND MAGNETISM (4)
- 402. ELECTRONICS (4)
- 404. ELECTRONIC MEASUREMENTS (2-4)
- 406. NUCLEAR PHYSICS (3)
- 411. THEORETICAL MECHANICS (3)
- 412. THEORY OF THE SOLID STATE (3)
- 417. THE TEACHING OF PHYSICS (3)
- 420. INTERMEDIATE HEAT (3)
- ‡ 433. MECHANICS AND FLUID PHYSICS (3)
- ‡ 435. ELECTRICITY AND MAGNETISM (3)
- ‡ 437S. INTERMEDIATE HEAT, SOUND, AND LIGHT (3)
- ‡ 439. ELEMENTARY SURVEY OF MODERN PHYSICS (3)
- 441. DEMONSTRATION EXPERIMENTS (3)
- 443. INTERMEDIATE ACOUSTICS (3)
- 444. MEASUREMENTS IN ACOUSTICS (2)
- 454, 454X. ATOMIC AND NUCLEAR PHYSICS (3)
- 456. ATOMIC AND NUCLEAR PHYSICS (3)
- 457. EXPERIMENTAL ATOMIC PHYSICS (2)
- 458. INTERMEDIATE OPTICS (4)
- 461. THEORETICAL MECHANICS (3)
- 467. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
- 473-474. BIOPHYSICS (3 each)
- 477. X-RAY ANALYSIS OF SOLIDS AND LIQUIDS (3)

- 507. THERMODYNAMICS (3) First and second laws, Carnot cycle, entropy, phase changes, low temperature phenomena.

- 509. PHYSICS SEMINAR (1) Selected topics from current physical research critically examined and discussed. May be continued in successive semesters as Phys. 509a, 509b, 509c.

- 512-513. SOLID STATE PHYSICS (3 each) Analytical treatment of physical properties of solids: crystal structure, X-ray diffraction, lattice vibrations, paramagnetism, ferromagnetism, ferroelectricity; electron theory of metals, semi-conductors. Prerequisite: Phys. 530.

- 517. STATISTICAL MECHANICS AND KINETIC THEORY (3) Maxwell-Boltzmann distribution, H-theorem, transport phenomena, ensembles, classical and quantum statistics. Prerequisite: Phys. 507.

- 521. CRYSTAL STRUCTURE (3) Solution of the structure of crystals by X-ray methods. Available for major credit in either physics or chemistry. Prerequisite: Chem. 440 or Min. 460 or Phys. 461.

† Phys. 433, 435, 437, and 439 are courses of intermediate scope and difficulty and are intended primarily for high school and other teachers who have had only one year of general physics in college and who wish to make a thorough review of and an advance in this field.

These four courses taken together form a connected sequence covering the entire field of general college physics. Any course may be taken without the others, but it is preferable that they be taken in sequence or concurrently.

522. **ADVANCED CRYSTAL ANALYSIS (3)** Continuation of Phys. 521, including the application of crystal structure studies to physical, chemical, and metallurgical problems. Available for major credit in either physics or chemistry.
- 530-531. **THEORETICAL PHYSICS (3 each)** Application of higher mathematics to problems in various fields of physics. Prerequisite: Phys. 411 or 467.
533. **THEORY OF SOUND (3)** Mathematical treatment of the theory of sound. Prerequisite: Phys. 530.
553. **NUCLEAR PHYSICS (3)** Mathematical course in nuclear physics. Prerequisite: Phys. 562.
- 557-558. **ELECTRICITY AND MAGNETISM (3 each)** Treatment of the mathematical theory of electricity and magnetism. Prerequisite: Phys. 531.
560. **ADVANCED PHYSICAL MEASUREMENTS (1-18)** Offers opportunity for advanced work in various fields of physics.
561. **DE BROGLIE WAVES AND QUANTUM MECHANICS (3)** Introduction to modern interpretation of atomic structure and radiation phenomena, based upon the de Broglie and Schroedinger wave theory. Prerequisite: Phys. 531.
562. **WAVE MECHANICS IN MODERN PHYSICS (3)** Continuation of Phys. 561. Theory of atomic and simple molecular spectra, Zeeman and Stark effect, theories of metallic conductivity and thermionic emission, etc. Prerequisite: Phys. 561.
571. **ATOMIC STRUCTURE (3)** Recent work in atomic and subatomic physics.
572. **SPECTROSCOPY (3)** Atomic and molecular spectra, both emission and absorption methods of excitation, radiation and ionization potentials, spectral series, fine structure, spectra of ionized and stripped atoms.
575. **PROBLEMS IN MODERN PHYSICS (1-3)** Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 456.

POLITICAL SCIENCE †

PROFESSOR ELTON ATWATER, *Acting Head of the Department*

The master's degree and the doctorate are offered in the field of Political Science. The Master of Public Administration degree is offered in a special program built around Pol.S. 560, 561, and 562.

411. **AMERICAN POLITICAL THEORY (3)**
413. **GOVERNMENT AND POLITICS OF THE SOVIET UNION (3)**
414. **FOREIGN POLICY OF THE SOVIET UNION (3)**
415. **INTERNATIONAL ORGANIZATION (3)**
416. **INTERNATIONAL LAW (3)**
417. **MUNICIPAL GOVERNMENT (3)**
419. **PUBLIC ADMINISTRATION (3)**
421. **MODERN POLITICAL THEORIES (3)**
- 424S. **STATE GOVERNMENT IN THE UNITED STATES (3)**
426. **POLITICAL PARTIES (3)**

POLITICAL SCIENCE

- 427. PUBLIC OPINION AND PROPAGANDA (3)
- 428. PENNSYLVANIA LOCAL GOVERNMENT (3)
- 429. PENNSYLVANIA LOCAL ADMINISTRATION (3)
- 431. ANCIENT AND MEDIEVAL POLITICAL THEORIES (3)
- 432. CURRENT POLITICAL TRENDS AND PROBLEMS IN THE UNITED STATES (3-9)
- 433. LABOR AND WELFARE LEGISLATION AND ADMINISTRATIVE PROBLEMS (3)
- 435. GOVERNMENT HOUSING, PLANNING, AND PUBLIC WORKS (3)
- 442. AMERICAN FOREIGN POLICY (3)
- 444. GOVERNMENT REGULATION (3)
- 445. ADMINISTRATIVE LAW (3)
- 446. JUDICIAL SYSTEMS (3)
- 450. GOVERNMENT AND FOREIGN POLICIES OF BRITAIN AND THE COMMONWEALTH (3)
- 456. GOVERNMENTS AND FOREIGN POLICIES OF LATIN AMERICA (3)
- 458. GOVERNMENTS AND FOREIGN POLICIES OF THE FAR EAST (3)
- 499X. FOREIGN STUDY IN GOVERNMENT (2-6)

- 500. SEMINAR IN POLITICAL SCIENCE (3-12) Subject to be announced.

- 505. SEMINAR IN ADVANCED AMERICAN GOVERNMENT (3-12)

- 508. RESEARCH IN PUBLIC ADMINISTRATION (3-12)

- 509. RESEARCH TECHNIQUES IN POLITICAL SCIENCE (3)

- 510. POLITICAL AND ADMINISTRATIVE PROBLEMS IN PENNSYLVANIA (3-6)

- 512. COMPARATIVE GOVERNMENT (3-12)

- 515. INTERNATIONAL RELATIONS (3-6)

- 517. INTERNATIONAL ORGANIZATION (3-6)

- 519. PUBLIC ADMINISTRATION (3-6)

- 521. POLITICAL THEORY (3-6)

- 535. GOVERNMENT REGULATION (3-6)

- 560. PUBLIC MANAGEMENT I (15) Organization, management, personnel, budgeting, accounting, and other fiscal procedures in government at all levels.

- 561. PUBLIC MANAGEMENT II (15) Administrative law, communications and report writing, statistics, public relations, public works administration, and planning in government at all levels. Prerequisite: Pol.S. 560.

- 562S. PUBLIC MANAGEMENT III (6) Supervised internship and report. Prerequisite: Pol.S. 561.

POULTRY HUSBANDRY†

PROFESSOR ERNEST W. CALLENBACH, *Head of the Department*

- 401. (Psy. 401, Zool. 401). ANIMAL BEHAVIOR (3)
- 412. POULTRY BREEDING (3)

Mr. Hale
Mr. Maw

POULTRY HUSBANDRY

502. ADVANCED POULTRY NUTRITION (2-4) Prerequisite: P.H. 3. *Mr. Murphy*
503. ADVANCED POULTRY FARM MANAGEMENT (2-4) Prerequisite: P.H. 8. *Mr. Bressler*
504. ADVANCED MARKET POULTRY AND EGGS (2-4) Prerequisites: P.H. 1, 7; Agr.Ec. 33 or 2 additional credits in poultry husbandry. *Mr. Margolf*
505. RESEARCH IN POULTRY HUSBANDRY (1-15 per semester) Prerequisite: 9 credits in poultry husbandry. *Mr. Callenbach and Staff*
506. SEMINAR IN POULTRY HUSBANDRY (1-6) *Mr. Callenbach and Staff*

PSYCHOLOGY †

PROFESSOR CLARENCE R. CARPENTER, *Head of the Department*

400. HONORS COURSE IN PSYCHOLOGY (2-6)
401. (P.H. 401, Zool. 401). ANIMAL BEHAVIOR (3) *Mr. Hale*
403. INTRODUCTORY PHYSIOLOGICAL PSYCHOLOGY (3)
407. INTERMEDIATE EXPERIMENTAL PSYCHOLOGY (3) *Mr. Lepley*
- 411, 411X. PSYCHOLOGY OF THE PRESCHOOL CHILD (3) *Mr. van Ormer*
- 412, 412X. ABNORMAL PSYCHOLOGY (3)
- 414, 414X. INTERMEDIATE EDUCATIONAL PSYCHOLOGY (2-3) *Mr. Thevaos*
- 415, 415X. INTERMEDIATE STATISTICS IN PSYCHOLOGY AND EDUCATION (3)
417. SOCIAL PSYCHOLOGY (2-3) *Mr. Carpenter*
418. MEASUREMENT OF PERSONALITY (3) *Mr. Bernreuter*
419. GUIDANCE AND EDUCATION IN SEXUAL AND MARITAL ADJUSTMENT (3) *Mr. Adams*
420. APPLIED SOCIAL PSYCHOLOGY (3) *Mr. Carpenter*
422. PSYCHOLOGICAL METHODS OF MEASURING THE REACTIONS OF THE PUBLIC (3) *Mr. Guest*
423. TEST CONSTRUCTION AND STANDARDIZATION (2-3)
- 424, 424X. PSYCHOLOGICAL TECHNIQUES IN PUBLIC PERSONNEL ADMINISTRATION (3) *Mr. Adams*
- 425, 425X. PSYCHOLOGY OF THE ELEMENTARY SCHOOL CHILD (2-3) *Mr. van Ormer*
- 426, 426X. ADOLESCENCE (2-3) *Mr. Thevaos*
427. PSYCHOLOGICAL PRINCIPLES IN ADVERTISING (3) *Mr. Guest*
428. OPINION RESEARCH LABORATORY (3) *Mr. Guest*
429. PSYCHOLOGY OF COMMUNICATION (3)
- 431, 431X. INDUSTRIAL PSYCHOLOGY (3) *Mr. Smith*
- 436, 436X. MENTAL HYGIENE IN SCHOOLS (3)
- 437, 437X. PSYCHOLOGY OF ADJUSTMENT (3) *Mr. Gorlow*
438. THEORY OF PERSONALITY (3) *Mr. Grosslight*
440. PSYCHOLOGY PROJECTS (1-6)
441. INDUSTRIAL MOTIVATION AND MORALE (3)
445. (Ch.Fm. 445). DEVELOPMENT THROUGHOUT ADULthood (3)
- 450, 450X. MEASUREMENT OF ABILITIES (3)
482. INTRODUCTION TO CLINICAL PSYCHOLOGY (3) *Mr. Snyder*
500. SEMINAR: INTRODUCTION TO GRADUATE STUDY (0) For all new graduate students in psychology.

PSYCHOLOGY

501. ADVANCED PSYCHOLOGY (3) Comprehensive study of general psychology. Prerequisite: 9 credits in psychology. *Mr. Lepley*
502. ADVANCED EDUCATIONAL PSYCHOLOGY (2-4) Psychological theories and principles underlying educational theories and practices. Prerequisites: Psy. 14 or 414; Ed. 31 or teaching experience. *Mr. van Ormer*
503. PHYSIOLOGICAL PSYCHOLOGY (2-6) Correlations between structure and function of nervous system and human consciousness; laws and theories in fields of sensation, attention, association, affection, and thought. Prerequisite: 9 credits in psychology.
504. COMPARATIVE PSYCHOLOGY (2-4) Behavior from standpoint of phylogenetic growth and development; biological implications; comparison of different types of animals, including man. Prerequisite: 9 credits in psychology. *Mr. Hale*
505. RESEARCH PROBLEMS IN PSYCHOLOGY (1-15) Prerequisite: 12 credits in psychology.
509. ADVANCED THEORY OF LEARNING AND HABIT FORMATION (2-3) Critical evaluation of major theories of learning: Hull, Guthrie, Tolman, Lewin. Application of learning theory to major problems in psychology. Prerequisite: Psy. 4 or 407 or 414. *Mr. Grosslight*
510. HISTORY OF PSYCHOLOGY (3) Theoretical systems, experiments, and personalities in development of modern psychology until about 1920. Prerequisite: 9 credits in psychology. *Mr. Carpenter*
511. CONTEMPORARY AMERICAN PSYCHOLOGY (2-3) Current systems or schools of psychology with comparative study and critical analysis; points of view as presented by recognized leaders. Prerequisite: 9 credits in psychology. *Mr. Hall*
513. EDUCATIONAL PSYCHOLOGY: DIFFERENTIAL (3) Causes of differences in achievement and personality; psychological implications of methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Mr. van Ormer*
514. EDUCATIONAL PSYCHOLOGY: LEARNING (2) Experimentally determined facts about the learning process; synthesis of main theories of learning; application of principles related to: motivation, practice, retention, transfer, meaning, and problem solving. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Mr. van Ormer*
515. ADVANCED STATISTICS IN PSYCHOLOGY AND EDUCATION (3) Correlation theory and methods, discriminant function, and factor analysis; applications to mental test theory. Prerequisite: Psy. 415 or Ed. 574.
517. PSYCHOLOGY OF ATTITUDES AND OPINIONS (3) Acquisition and control of attitudes and opinions, including beliefs, convictions, biases, prejudices, and ideologies as determinants of action. Prerequisite: 18 credits in psychology, including Psy. 417, 422, 437.
518. PROJECTS IN EXPERIMENTAL PSYCHOLOGY (2-4) Individual experimental projects; seminars on experimental design and instrumentation. Prerequisite: Psy. 407.
522. ADVANCED PSYCHOLOGICAL MARKETING RESEARCH TECHNIQUES (3) Questionnaire designs to test consumer reaction to products, advertising, and company policies from psychological standpoint. Prerequisite: 3 credits in statistics. *Mr. Guest*

525. SAMPLING DESIGNS IN MARKET AND OPINION RESEARCH (3) Techniques in selection of samples for accurate representation of human populations; special emphasis on probability sampling. Prerequisite: 3 credits in statistics. *Mr. Guest*
527. STATISTICAL INFERENCE AND EXPERIMENTAL DESIGN (3) Probability theory, sampling distributions, analysis of variance and covariance, analysis of trend, nonparametric statistics, experimental design. Prerequisite: Psy. 415 or Ed. 574.
528. OPINION RESEARCH ADMINISTRATION (3-6) Practicum in planning, development of techniques, and administration of the sample survey. Prerequisites: Psy. 15, 21, 422. *Mr. Guest*
529. (Ch.Fm. 529). SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisite: 6 credits in child development or 6 in educational or child psychology, plus 3 in statistics.
534. APPLICATIONS OF PSYCHOLOGY IN BIO-MECHANICS (3) Experimental studies of psychological factors affecting design and operation of machines. Prerequisites: Psy. 3 and 4, or 501. *Mr. Corso*
- 535, 535X. HUMAN DEVELOPMENT (2-3) Psychological phases of human development throughout the life span; implications for school, community, and home. Prerequisite: 9 credits in psychology.
536. RESEARCH METHODS AND PROBLEMS IN EDUCATIONAL AND DEVELOPMENTAL PSYCHOLOGY (1-6) Prerequisites: Psy. 414 or 514; Ed. 470 or Psy. 415.
537. SEMINAR IN INDUSTRIAL PSYCHOLOGY (3) Prerequisite: Psy. 431.
538. PSYCHOLOGY OF PERSONNEL DEVELOPMENT (3) Industrial training in relation to psychological learning theory and experimental findings. Prerequisite: Psy. 431 or 414.
539. MOTIVATION AND EMOTION (3) Systematic status of instinct, drive, motive, will, purpose; methodology and results of physiological, experimental, and clinical investigation of basic drives. Prerequisite: Psy. 503.
540. CLINICAL PSYCHOLOGY SEMINAR (1-6) Seminar on current problems in clinical psychology. Prerequisite: Psy. 482.
541. DYNAMICS OF HUMAN ADJUSTMENT (3) Seminar on motivation of human behavior, frustration, and mechanisms of adjustment; normal behavior is stressed. Prerequisite: Psy. 437. *Mr. Gorlow*
542. PSYCHOPATHOLOGY (3) Covers basic, developmental, human, experimental reactions, showing how normal and pathological character trends and deviations evolve; basic reasons for and applications of psychotherapeutic methods. Prerequisite: Psy. 412 or 437. *Dr. Lott*
543. COUNSELING TECHNIQUES (2) Survey of psychotherapeutic methods; history, theory, and methods employed; case illustrations. Prerequisite: Psy. 482. *Mr. Snyder*
550. PSYCHOMETRICS: BINET (2) Measurement of intelligence by Stanford revision of the Binet-Simon technique; demonstrations, lectures; practice administering tests; observations of student by instructor. Prerequisite: Psy. 450.

PSYCHOLOGY

551. PSYCHOMETRICS: POINT SCALES (2) Measurement of intelligence by individual nonverbal techniques: Arthur, Wechsler-Bellevue, and others; demonstrations, lectures, and practice administering tests under observation. Prerequisite: Psy. 450.
552. PSYCHOMETRICS: PRESCHOOL (2) Measurement by individual preschool scales: Merrill-Palmer, Minnesota, California First Year; demonstrations, lectures, and practice in administering tests under observation. Prerequisite: Psy. 551.
553. PSYCHOMETRICS: ADVANCED (2) Measurement of intelligence, social maturity, and other characteristics; demonstration, lectures, and practice in administering tests; observations by instructor. Prerequisite: Psy. 550. *Mr. Bernreuter*
555. PSYCHOMETRICS: RORSCHACH ADMINISTRATION (3) Introduction to theory of projective tests; supervised practice in administering and scoring of the Rorschach test. Prerequisite: Psy. 550 or 551. *Messrs. Guthrie and Gorlow*
556. PSYCHOMETRICS: RORSCHACH INTERPRETATION (3) Study of current literature and supervised practice. Prerequisite: Psy. 555. *Messrs. Guthrie and Gorlow*
557. PSYCHOMETRICS: ADVANCED PROJECTIVE TECHNIQUES (2-3) Survey of common projective techniques other than the Rorschach, with supervised practice. Prerequisite: Psy. 556. *Messrs. Guthrie and Gorlow*
560. CLINICAL PRACTICUM (2-3) Applied experience in techniques of clinical psychology; case work in the Psychology Clinic. Prerequisites: Psy. 482, 550, 551.
561. CLINICAL PRACTICUM: ELEMENTARY SCHOOL (1-3) Experience in the Psychology Clinic and public schools in learning and adjustment problems; diagnosis and remedial work; pertinent school laws and practices. Prerequisites: Psy. 560 and Ed. 70, or Ed. 432g or 470.
562. CLINICAL PRACTICUM: VOCATIONAL GUIDANCE (1-3) Practical experience in the Psychology Clinic on high school, college, and adult vocational guidance cases; staff meetings; seminar on techniques and materials. Prerequisite: Psy. 560 or Ed. 502.
563. CLINICAL PRACTICUM: MARITAL COUNSELING (1-3) Experience in the Psychology Clinic on premarital and marital adjustment; seminar on techniques of adjustment and development of sexual and emotional maturity in marriage. Prerequisite: Psy. 560. *Mr. Adams*
- 564, 564X. CLINICAL PRACTICUM: PERSONAL ADJUSTMENT COUNSELING (2-3) Advanced practicum with experience in counseling of personal adjustment problems referred to the Psychology Clinic. Prerequisite: Psy. 565. *Mr. Snyder*
565. CLINICAL PRACTICUM: NONDIRECTIVE COUNSELING (3) Practical experience in application of the nondirective method, along with systematic theoretical study of the method. Prerequisites: Psy. 543, 560. *Mr. Snyder*
566. CLINICAL PRACTICUM: HYPNOTHERAPY (1-3) Practical experience in the Psychology Clinic in use of hypnotherapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.
567. CLINICAL PRACTICUM: PLAY THERAPY (1-3) Practical experience in the Psychology Clinic in use of play therapy with young children; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

568. **CLINICAL PRACTICUM: GROUP THERAPY (2)** Practical experience in the Psychology Clinic in use of group methods for treatment of personal maladjustments; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565.
Mr. Gorlow
569. **CLINICAL PRACTICUM: ADVANCED NONDIRECTIVE (2)** Practical experience in the Psychology Clinic in advanced nondirective therapy techniques; staff meetings; case conferences. Prerequisite: Psy. 565.
Mr. Snyder
570. **INTERNSHIP IN PROFESSIONAL PSYCHOLOGY (1-9)** Internship, under supervision of graduate faculty, in institution with practicing psychologists, where student is not regularly employed. Prerequisite: 3 semesters of graduate work in psychology.
Unit A. Comparative Psychology
Unit B. Educational and Developmental Psychology
Unit C. General Experimental Psychology
Unit D. Industrial and Business Psychology
Unit E. Social Psychology
Unit F. State Institutional Psychology
574. **MENTAL DEFICIENCY (3)** Causes of mental deficiency; diagnosis, training, and care of mental defectives. Prerequisite: Psy. 414 or 482.
580. **THEORY AND CONSTRUCTION OF ATTITUDE SCALES (3)** Measurement of social, political, commercial, and industrial attitudes; questionnaire designs. Prerequisite: 3 credits in statistics.
590. **SEMINAR: ADVANCED (1-2)** Prerequisite: Psy. 500.
591. **SEMINAR ON TEACHING PSYCHOLOGY (1-3)** Objectives and content of psychology; organization and presentation of material; teaching aids and techniques.
Mr. Hall

RECREATION EDUCATION †

Consult PROFESSOR FRED M. COOMBS

430. **CAMPING AND OUTDOOR EDUCATION (3)**
432. **RECREATION IN INDUSTRY (3)**
434. **RECREATION AREAS AND FACILITIES (3)**
- 456, 456X. **SOCIAL RECREATION (3)**
- 461, 461X. **COMMUNITY RECREATION (3)**
462. **RECREATION FOR THE HANDICAPPED (3)**
- 465, 465X. **ADMINISTRATION OF RECREATION (3)**
530. **CAMP ADMINISTRATION (3)** Camp site development; staff selection, training, and supervision; development of objectives and program planning; values inherent in outdoor and camping education. Prerequisite: Rec.Ed. 430.
533. **RECREATION STUDIES, SURVEYS, AND APPRAISALS (3)** Types, purposes, and methods of conducting recreation studies and surveys; procedures in appraisal of community recreation. Prerequisite: Ph.Ed. 530.
560. **ADMINISTRATIVE PROBLEMS OF RECREATION (3)** Administrative problems in park and recreation departments; departmental organization, finance, personnel, facilities, program, and public relations. Prerequisite: Rec.Ed. 465.

ROMANCE LANGUAGES†

PROFESSOR FRANKLIN B. KRAUSS, *Head of the Department*

The master's degree and the doctorate are offered with a major in Romance Languages. Courses are provided in French, Italian, Portuguese, Spanish, Romance literature, and Romance philology.

FRENCH

- 400. FRENCH LITERATURE OF THE RENAISSANCE (3)
- 405. FRENCH LITERATURE IN THE ROMANTIC PERIOD (3)
- 406. FRENCH LITERATURE IN THE REALISTIC PERIOD (3)
- 411. FRENCH PROSE OF THE 20TH CENTURY (3)
- 413, 413X. CONTEMPORARY FRENCH DRAMA (3)
- 416. FRENCH POETRY AND DRAMA OF THE 20TH CENTURY (3)
- 421. THE TEACHING OF ROMANCE LANGUAGES (3)
- 431. FRENCH LITERATURE OF THE CLASSICAL PERIOD (3)
- 433. THE AGE OF ENLIGHTENMENT (3)
- 437. THE FRENCH ANALYTICAL NOVEL (3)
- 471. PROBLEMS IN FRENCH LITERATURE (3-6)
- 490. ADVANCED COMPOSITION AND CONVERSATION (3)
- 496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

- †1G. ELEMENTARY FRENCH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.

- 501. FRENCH DRAMA OF THE CLASSICAL PERIOD (3) Origins and development of French classical comedy and tragedy, emphasizing the works of Corneille, Racine, and Molière.

- 549. SYMBOLISM (3) The anti-positivistic tradition in 19th century French literature dealing with the Symbolist School, its antecedents and its subsequent ramifications.

- 552. MEDIEVAL FRENCH LITERATURE (3) Familiarizes the student with Old and Middle French texts from the earliest monuments to Villon. Prerequisite: Rom.Ph. 551.

- 553. FRENCH LITERATURE OF THE RENAISSANCE (3) The French Renaissance from 1498 to 1548.

- 562. FRENCH THINKERS OF THE 18TH CENTURY (3)

- 564. FRENCH ROMANTICISM (3) The French Romantic movement after 1830.

- 570. VOLTAIRE AND ROUSSEAU (3)

- 571. SEMINAR IN FRENCH LITERATURE (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

† No graduate credit is given for this course.

572. SEMINAR IN FRENCH LITERATURE (3) Continuation of Fr. 571.
 580. PROUST AND GIDE (3)

ITALIAN

571. SEMINAR IN ITALIAN LITERATURE (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

PORTUGUESE

571. SEMINAR IN PORTUGUESE LITERATURE (3-6) Prerequisite: Port. 4.

SPANISH

401. THE GOLDEN AGE (3)
 402. DRAMA OF THE GOLDEN AGE (3)
 403. DON QUIXOTE (3)
 404. OLD SPANISH LANGUAGE AND LITERATURE (3)
 405. SPANISH DRAMA OF THE 19TH CENTURY (3)
 406. CONTEMPORARY SPANISH DRAMA (3)
 407. THE SPANISH NOVEL OF THE 19TH CENTURY (3)
 408. THE CONTEMPORARY SPANISH NOVEL (3)
 409, 409X. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)
 410. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)
 411. MEXICO: ITS LANGUAGE AND LITERATURE (3)
 412. ARGENTINA: ITS LANGUAGE AND LITERATURE (3)
 415. MODERN SPANISH LYRIC POETRY (3)
 417. SPANISH LITERATURE IN THE ROMANTIC PERIOD (3)
 421. THE TEACHING OF ROMANCE LANGUAGES (3)
 471. PROBLEMS IN SPANISH LITERATURE (3-6)
 490. ADVANCED COMPOSITION AND CONVERSATION (3)
 496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

‡1G. ELEMENTARY SPANISH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.

501. GOLDEN AGE LITERATURE (3) Nature and development of Spanish literature of the 16th and 17th centuries.
 538. THE GENERATION OF 1898 (3) Principal works and intellectual trends of the period with special emphasis on Unamuno.
 549. MODERNISMO (3) The movement, its antecedents, and its followers, with special emphasis on Rubén Darío.
 552. MEDIEVAL SPANISH LITERATURE (3) Familiarizes the student with Old Spanish texts.

‡ No graduate credit is given for this course.

ROMANCE LANGUAGES

- 561-562. SPANISH DRAMA PREVIOUS TO LOPE DE VEGA (3 each) Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed.
565. LOPE DE VEGA (3)
566. LOPE DE VEGA'S FOLLOWERS (3)
- 567-568. CERVANTES AND HIS WORKS (3 each)
571. SEMINAR IN SPANISH LITERATURE (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.
572. SEMINAR IN SPANISH LITERATURE (3) Continuation of Sp. 571.

ROMANCE LITERATURE

544. NEOCLASSICISM IN THE ROMANCE LITERATURES (3) The neoclassical movement in the Romance literatures, with emphasis on French and Spanish.
545. ROMANTICISM IN THE ROMANCE LITERATURES (3) The Romantic movement in the Romance literatures, with emphasis on French and Spanish.
546. MEDIEVAL ROMANCE LITERATURES (3) Medieval writings in the Romance literatures, with emphasis on French and Spanish.
547. REALISM IN THE ROMANCE LITERATURES (3) The Realistic movement in the Romance literatures, with emphasis on French and Spanish.
554. THE RENAISSANCE IN THE ROMANCE LITERATURES (3) The effect of the Renaissance on the Romance literatures, with emphasis on French and Spanish.

ROMANCE PHILOLOGY

551. ROMANCE PHILOLOGY (3)
558. ADVANCED LINGUISTICS AND PHONETICS OF THE ROMANCE LANGUAGES (3)
574. METHODS AND BIBLIOGRAPHY IN ROMANCE LANGUAGES AND LITERATURES (1-2)

RURAL SOCIOLOGY †

PROFESSOR MACKLIN E. JOHN

Head of the Department of Agricultural Economics and Rural Sociology

452. RURAL ORGANIZATION (3)
454. RURAL SOCIAL WELFARE (3)
456. RURAL STANDARDS OF LIVING (3)
459. RURAL SOCIAL PSYCHOLOGY (3)

551. RURAL SOCIOLOGY SEMINAR (1-6) Prerequisite: 6 credits in rural sociology, sociology, or psychology.
552. ADVANCED RURAL SOCIOLOGY (3) Structure and functioning of rural society.
553. SEMINAR IN RURAL SOCIOLOGICAL RESEARCH (1-6) Continuation of R.Soc. 552. Functioning of rural society; research dealing with the subject reviewed and evaluated.
554. ADVANCED RURAL SOCIAL WELFARE (3) Analysis of welfare techniques and their application to rural situations. Prerequisites: R.Soc. 11; Psy. 2 or R.Soc. 459.
555. THE RURAL CHURCH (3) The rural church as a social institution; its relation to the community; the church in "problem" areas; effects of population trends on the program of the rural church; use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology.
557. THE DEVELOPMENT OF THE RURAL COMMUNITY (3) Origin and evolution of the rural community under different geographic and cultural conditions. Prerequisites: R.Soc. 11 or Soc. 1; R.Soc. 452.
559. ADVANCED RURAL SOCIAL PSYCHOLOGY (3) Application of social psychological principles to treatment of rural problems. Prerequisites: R.Soc. 11, Psy. 2.

SOCIAL STUDIES *

Consult PROFESSOR NEIL A. McNALL

The Master of Education degree is offered with a major in Social Studies. The program, which is designed to meet the needs of secondary school teachers, consists of at least 24 credits chosen from economics, history, political science, and sociology and a minor of at least 6 credits in basic education. A candidate is expected to complete at least one course in each of the four social science fields and at least 12 credits in one of them.

SOCIOLOGY †

PROFESSOR WILLIAM G. MATHER, *Head of the Department*

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| 401. SOCIAL INSTITUTIONS (3) | <i>Mr. Green</i> |
| 403. ADVANCED SOCIAL PSYCHOLOGY (3) | <i>Mr. Coutu</i> |
| 405S. SOCIAL PROBLEMS (3) | |
| 408. SOCIAL ECOLOGY (3) | |
| 413. METHODS AND TECHNIQUES OF SOCIAL RESEARCH (1-6) | <i>Mrs. Bernard</i> |
| 418. THE DEVELOPMENT OF SOCIAL THOUGHT (3) | |
| 423. POPULATION RESEARCH (3) | <i>Mr. Clark</i> |
| 424. SOCIAL CHANGE (3) | <i>Mr. Abramson</i> |

SOCIOLOGY

425. CONTEMPORARY SOCIOLOGICAL THEORY (3) *Mr. Green*
 426. INTRODUCTION TO PUBLIC WELFARE (3) *Mr. Mather*
 427S. FAMILY CASE WORK (6)
 429. SOCIAL STRATIFICATION (3)
 431. COMMUNICATION AND MASS SOCIETY (3) *Mr. Abramson*
 470. USE OF STATISTICS IN SOCIOLOGY (3) *Mr. Clark*
 495S. (Ch.Fm. 495S, Ed. 495S, Hl.Ed. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3)
 499X. FOREIGN STUDY IN SOCIOLOGY (2-6)
 503. SEMINAR IN SOCIAL PSYCHOLOGY (3-9) Investigation of theories, methods, and empirical data of social psychology, with particular reference to such problems as relations between personality and culture, social and personal disorganization, development of role behavior, and conception of the self. *Mr. Coutu*
 510. FIELD WORK IN SOCIOLOGY (1-6)
 513. SEMINAR IN SOCIOLOGICAL RESEARCH PROBLEMS: A. RESEARCH TECHNIQUES; B. CURRENT RESEARCH (3-6) Prerequisites: Soc. 413; 3 credits in statistics. *Mr. John, Mrs. Bernard*
 515. SEMINAR IN COMMUNITY STUDIES (3) *Mrs. Bernard*
 516. SEMINAR IN SOCIOLOGICAL THEORY (3-9) *Messrs. Green and Blizzard*
 523. POPULATION PROBLEMS (1-9) *Mr. Clark*
 525. SEMINAR IN SOCIOLOGY (1-9) Research problems in theoretical and applied sociology.
 530. RESEARCH ON MARRIAGE AND THE FAMILY (3) Training in methods and techniques of research in family relations. Under the guidance of the instructor, experimental, statistical, and comparative studies are carried out, individually or co-operatively. Prerequisite: 3 credits of previous work in this field. *Mrs. Bernard*
 572. METHODS OF SAMPLING (3) Application of sampling techniques to sociological research. *Mr. Clark*

SPEECH †

PROFESSOR ROBERT T. OLIVER, *Head of the Department*

- 400, 400X. TEACHING OF SPEECH (3) *Mr. Schug*
 401. PROBLEMS, METHODS, AND AREAS IN SPEECH (3) *Mr. Carter*
 402. INTRODUCTION TO GENERAL SEMANTICS (3) *Mr. Carter*
 410. ENGLISH PHONETICS AND PRONUNCIATION (3) *Mr. Brubaker*
 411a,b,cS. SPEECH SCIENCE AND SPEECH ARTS (1-3)
 412. SPEECH COMPOSITION (3) *Mr. DeBoer*
 415. EXPERIMENTAL AND APPLIED PHONETICS (3) *Mr. Brubaker*
 425. ADVANCED PRINCIPLES OF RADIO SPEECH (3) *Mr. Mackey*
 431. ANATOMY AND PHYSIOLOGY OF THE EAR AND VOCAL MECHANISMS (3) *Mr. Brubaker*

435. RADIO ORGANIZATION (3) *Mr. Nelson*
437. PRINCIPLES OF TELEVISION SPEECH (3) *Mr. Nelson*
445. SPEECH AS A MEDIUM OF INTERNATIONAL RELATIONS (3) *Mr. Oliver*
450. DISCUSSION TECHNIQUES (3) *Mr. Joseph O'Brien*
500. SEMINAR IN AMERICAN ORATORY (2-4) History of American oratory, with application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Spch. 200. *Mr. Joseph O'Brien*
505. HISTORICAL DEVELOPMENT OF SPEECH THEORY (2-4) Survey of ancient, medieval, and modern theories of public address in relation to currently accepted speech theories. *Mr. DeBoer*
508. SEMINAR IN BRITISH ORATORY (2-4) History of British oratory; application of critical standards to the work of selected orators. *Miss Fife*
510. SEMINAR IN METHODS OF TEACHING SPEECH (2-4) Curriculum construction, media, and methods in high school and college. Prerequisite: 6 credits in speech including Spch. 200. *Mr. Joseph O'Brien*
520. SEMINAR IN SPEECH SCIENCE (2-4) Seminar in physical and physiological bases of speech and voice; introduction to laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology. *Mr. Brubaker*
540. SEMINAR IN THE PROBLEMS OF RADIO (3) Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 credits in speech including Spch. 200, 300; 425 or 435. *Mr. Nelson*
550. SEMINAR IN ORAL PERSUASION (2-4) Theory and devices of persuasion; analysis of persuasive discourse. Prerequisite: 6 credits in speech including Spch. 200. *Mr. Oliver*
555. SPEECH COMMUNICATION: PROBLEMS AND PRINCIPLES (2-4) Prevalent theories of speech influence. *Mr. Oliver*
560. PUBLIC ADDRESS (2-4) Discussion and criticism of speech outline, manuscript, content, composition, and delivery. Prerequisite: 6 credits in speech including Spch. 200. *Mr. Schug*
575. RESEARCH PROBLEMS IN SPEECH (1-12) Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

STATISTICS

Consult PROFESSOR HENRY R. FORTMANN

No advanced degree is offered in this field, but a candidate with a major in another field may choose a minor in Statistics with the approval of his major department.

WILDLIFE MANAGEMENT *

Consult PROFESSOR BERTIL G. ANDERSON

The master's degree is offered in the field of Wildlife Management. Candidates select courses for this major from a number of related fields.

ZOOLOGY *

PROFESSOR BERTIL G. ANDERSON

Head of the Department of Zoology and Entomology

- | | |
|--|---------------------------|
| 401. (P.H. 401, Psy. 401). ANIMAL BEHAVIOR (3) | <i>Mr. Hale</i> |
| 405. (Bot. 405). GENERAL CYTOLOGY (3) | |
| 408. MAMMALOGY (4) | <i>Mr. English</i> |
| 410. GENERAL LIMNOLOGY (3) | |
| 415. THE LITERATURE OF ZOOLOGY (1) | <i>Mr. B. G. Anderson</i> |
| 416. THE METHODS OF RESEARCH IN ZOOLOGY (2) | <i>Mr. B. G. Anderson</i> |
| 417. INVERTEBRATE ZOOLOGY (3) | <i>Mr. Frings</i> |
| 418S. FIELD ORNITHOLOGY (3) | <i>Mr. Wood</i> |
| 419. GENERAL ANIMAL ECOLOGY (3) | <i>Mr. Blackburn</i> |
| 420. GAME BIRDS (3) | <i>Mr. English</i> |
| 421. COMPARATIVE ANATOMY OF VERTEBRATES (4) | |
| 422. (Bot. 422). ADVANCED GENETICS (3) | <i>Mr. Wright</i> |
| 432. HUMAN PARASITOLOGY (3) | <i>Mr. Zelif</i> |
| 433S. (Bot. 433S). GENETICS, EUGENICS, AND EVOLUTION (3) | |
| 436. PROTOZOOLOGY (3) | <i>Mr. Zelif</i> |
| 437. HISTOLOGY (4) | <i>Mr. Newman</i> |
| 440. EMBRYOLOGY (4) | <i>Mr. Newman</i> |
| 441S. ESSENTIALS OF HUMAN PHYSIOLOGY (3) | |
| 444. ZOOLOGICAL PROBLEMS (1-6) | |
| 448. ORNITHOLOGY (3) | <i>Mr. Wood</i> |
| 450. ICHTHYOLOGY (4) | |
| 461. ANIMAL PARASITOLOGY (3) | <i>Mr. Zelif</i> |
| | |
| 505. (Bot. 505). CYTOLOGY AND CYTOGENETICS (3) Structure and function of the cell and components; growth, differentiation, reproduction; chromosome mechanism of heredity; cytological and cytochemical techniques; cytology in study of evolution. Prerequisite: Bot. 22 or Zool. 22. | <i>Mr. Grun</i> |
| 508. ADVANCED PARASITOLOGY (3) Advanced work on the structure, life cycle, and control of parasites. Prerequisites: Ent. 2, Zool. 432. | <i>Mr. Zelif</i> |
| 509. TECHNIQUES IN WILDLIFE MANAGEMENT (3) Preparing study mounts, census making, management area mapping, methods of collecting data, and determining food habits from stomach contents. Prerequisite: Zool. 546. | <i>Mr. English</i> |
| 512. SEMINAR (1) Review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology. | |

514. SPECIAL TOPICS IN ZOOLOGY (3) Individual problems in any field of zoology, with or without experimental work. Prerequisite: Zool. 26.
524. (Bot. 524). SEMINAR IN GENETICS (1 per semester) *Mr. Wright*
528. (Bot. 528). POPULATION GENETICS (3) Factors affecting gene frequency, genotype frequency, genotype-environmental interaction, and genetic relationship in natural and artificial populations. *Mr. Mitchell*
- 532S. ANIMAL PARASITES (3) Structure, life cycle, and control. Prerequisite: Zool. 432.
- 537S. (Bot. 537S, Ed. 537S). WORKSHOP IN THE BIOLOGICAL SCIENCES (3) Projects designed for teachers of biology in the secondary schools.
541. COMPARATIVE PHYSIOLOGY (3) Dynamics of vital processes as shown in members of the animal kingdom. Prerequisites: Zool. 26, A.B.Ch. 1, A.B.Ch. 425 and Zool. 437. *Mr. Frings*
546. THE THEORY OF GAME MANAGEMENT (4) Fundamental principles underlying management of wild game birds and mammals; co-ordination of such management with various land uses; planning preserves and other land areas. Prerequisites: Zool. 408, 420. *Mr. English*
- 547S. WILDLIFE MANAGEMENT (3) Basic principles concerned with management of game birds and game mammals. Prerequisite: Zool. 420. *Mr. English*
551. FISHERIES MANAGEMENT (3) Basic principles underlying management of inland waters for fish production. Prerequisite: Zool. 450.
581. ADVANCED INVERTEBRATE ZOOLOGY (3) Morphology, physiology, taxonomy, and life histories of invertebrate animals. *Mr. Frings*
583. GENERAL ENDOCRINOLOGY (2) Anatomy and physiology of the organs of internal secretion; role of hormones in metabolism and development. *Mr. Anthony*
587. BIOLOGY OF SEX (2) Hereditary and embryological aspects, problems in gonadal differentiation, cyclic reproductive phenomena, actions of the hormones. *Mr. Anthony*

Part II

Other Elective Graduate Courses

The following courses involve fields in which neither major nor minor work is offered at this institution. The courses, however, carry graduate credit and, with the approval of the major department, may be applied toward the requirements for a degree either as elective courses or as a part of a general studies program. The usual restrictions upon the use of 400 series courses in degree programs apply to these courses.

AGRICULTURE, GENERAL

400. INTRODUCTORY BIOMETRY (3)

ARCHAEOLOGY

- | | |
|--|-------------------|
| 400-401. ARCHAEOLOGY OF THE NEAR EAST (3 each) | <i>Mr. Matson</i> |
| 402-403. ARCHAEOLOGY OF THE NEW WORLD (3 each) | <i>Mr. Matson</i> |

ASTRONOMY

430. GENERAL ASTRONOMY FOR TEACHERS (3)
470. SOLAR PHYSICS (3)
486. ASTRONOMICAL PHOTOGRAPHY (3)
490-491. INTRODUCTION TO ASTROPHYSICS (3 each)

COMMERCIAL CONSUMER SERVICES

- | | |
|--|---------------------|
| 403. LECTURE-DEMONSTRATION TECHNIQUES (3) | <i>Miss Allgood</i> |
| 450. PROBLEMS IN HOUSEHOLD EQUIPMENT (1-6) | <i>Miss Allgood</i> |

ENGINEERING

410. NUCLEAR ENGINEERING (3)
411. NUCLEAR ENGINEERING (3)
422. ORDNANCE ENGINEERING: TORPEDO ENGINEERING (3)
430. INTRODUCTION TO DIGITAL COMPUTER PROGRAMMING (1)
431. DIGITAL COMPUTER PROGRAMMING (3)
531. ADVANCED DIGITAL COMPUTER PROGRAMMING (3) Programming for commercial computers; programming techniques; numerical methods for computers; solution of problems on the Penn State Digital Computer. Prerequisites: Math. 405, Eng. 431.

GREEK

- 411S. ESSENTIALS OF GREEK (3)
 421. GREEK TRAGEDY (3) *Mr. Will*
 422. GREEK COMEDY (3) *Mr. Will*
 423. ATTIC ORATORS (3) *Mr. Will*
 424. GREEK HISTORY OR PHILOSOPHY (3) *Mr. Will*
 427. NEW TESTAMENT GREEK (3) *Mr. Will*
500. GREEK COMPOSITION (2) Translation of extended narrative passages into Attic Greek; thorough review of forms and syntax; attention to rhetorical elements of the language. *Mr. Will*

HOME-COMMUNITY RELATIONSHIPS

- 499X. INTERCULTURAL STUDIES IN HOME ECONOMICS (2-6)
- 502, 502v, 502X, 502vX. HOME ECONOMICS AND AMERICAN SOCIETY (3) Family life education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.
503. GRADUATE SEMINAR IN HOME ECONOMICS (1) *Miss Henderson*

HOUSING AND HOME EQUIPMENT

- 413, 413X. HOME EQUIPMENT (3)
 470, 470X. HOUSING THE FAMILY (2-3) *Miss Johnston*

INTERNATIONAL UNDERSTANDING

- 400S. WORLD AFFAIRS AND INTERNATIONAL UNDERSTANDING (3-6)

LATIN

428. LUCRETIVS (3) *Mr. Krauss*
 429. QUINTILIAN (3) *Mr. Krauss*
 431. JUVENAL (3) *Mr. Krauss*
 436S. FUNCTIONAL PROBLEMS IN LATIN (3)
 440a,b,c,dS. COLLEGE LATIN (3-12)
500. LATIN LITERATURE (3) Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures. *Mr. Krauss*
501. ROMAN RELIGION AND PHILOSOPHY (3) Development of religious concepts at Rome from primitive Italic origins to the advanced forms that culminated in Roman Stoicism. *Mr. Krauss*
502. LATIN EPIGRAPHY (3) Lectures and readings on Roman inscriptions; illustrative exercises. *Mr. Krauss*

ELECTIVE COURSES

503. LATIN PALEOGRAPHY (3) The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises. *Mr. Krauss*
504. ROMAN TOPOGRAPHY (3) Physical development of the city of Rome, its walls, aqueducts, bridges, streets, forums, public buildings, temples, etc.; building materials and methods of construction. *Mr. Krauss*
510. LATIN SEMINAR (3) *Mr. Krauss*
518. LATIN RESEARCH (1-3) Prosecution of an assigned problem under the guidance of a member of the department.

MINERAL INDUSTRIES

400. MINERAL INDUSTRIES IN MODERN CIVILIZATION (3)

MINERAL SCIENCES

411. INSTRUMENT TECHNIQUES APPLIED TO MINERAL SCIENCE PROBLEMS (1-3)
Unit A. X-Ray Diffraction
Unit B. Electron Microscopy
Unit C. Spectroscopy
510. X-RAY AND ELECTRON DIFFRACTION ANALYSIS AS APPLIED TO MINERALS AND METALS (2) Prerequisite: Phys. 285. *Mr. Brindley*
520. ELECTRON MICROSCOPY IN MINERAL SCIENCE RESEARCH (1-4) Prerequisite: Min. Sc. 411, Unit B. *Messrs. Bates and Comer*
530. SPECTROSCOPY IN MINERAL SCIENCE RESEARCH (1-4) Prerequisite: Min.Sc. 411, Unit C. *Mr. Lovell*
540. SOLID STATE STRUCTURES AND REACTIONS IN MINERAL SYSTEMS (2-4) Crystal chemical approach to solid state reactions, sintering, melting, hardness, thermal expansion, and behavior of matter under high pressure.

PUBLIC UTILITIES

421. ELECTRIC UTILITIES (3) *Mr. Powell*

RUSSIAN

401. STUDIES IN RUSSIAN LITERATURE (3-6)
425. PUSHKIN (3)
426. DOSTOEVSKI (3)
427. TOLSTOY (3)

VETERINARY SCIENCE

400. VETERINARY ANATOMY AND PHYSIOLOGY (3)
401. INFECTIOUS DISEASES OF DOMESTIC ANIMALS (2)
515. (Bact. 515). VIROLOGY (2-4) Rickettsial and viral agents parasitizing man, animals, and microorganisms. Prerequisite: Bact. 410.

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THE PENNSYLVANIA STATE UNIVERSITY
GRADUATE SCHOOL ANNOUNCEMENT
UNIVERSITY PARK, PENNSYLVANIA

THE PENNSYLVANIA STATE UNIVERSITY BULLETIN



GRADUATE SCHOOL
ANNOUNCEMENT ~ 1957-1958

OFFICE OF THE DEAN OF ADMISSIONS
110 Willard Hall

OFFICE OF THE DEAN OF THE GRADUATE SCHOOL
116 Willard Hall



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THE PENNSYLVANIA STATE
UNIVERSITY BULLETIN

*Graduate School
Announcement*

1957-1958



UNIVERSITY PARK, PENNSYLVANIA

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GRADUATE CALENDAR

SPRING SEMESTER 1957

JANUARY 1957

Jan. 30- }
Feb. 2 } Wednesday to Saturday—Spring Semester Registration

FEBRUARY

- 4 Monday—Spring Semester Classes Begin 8 a.m.
- 16 Saturday—Last Date for Students to Add Courses
- 21 Thursday—Graduate Faculty Meeting 4:10 p.m.

MARCH

- 2 Saturday—Last Date for Students to Drop Courses
- 4 Monday—Foreign Language Examinations for Doctorates
- 21 Thursday—Graduate Faculty Meeting 4:10 p.m.

APRIL

- 17 Wednesday—Spring Recess Begins 11:50 a.m.
- 24 Wednesday—Spring Recess Ends 1:10 p.m.

MAY

- 11 Saturday—Last Date for a June Graduate to Deliver Doctoral Thesis to Committee
- 16 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 18 Saturday—Last Date for a June Graduate to Deliver Master's Thesis to Adviser
- 18 Saturday—Last Date for Final Oral Doctoral Examination for June Graduates
- 18 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 25 Saturday—Spring Semester Classes End 11:50 a.m.
- 25 Saturday—Theses Due in Graduate School Office 12 noon
- 25 Saturday—Spring Semester Examinations Begin 1:10 p.m.
- 30 Thursday—Memorial Day Recess

JUNE

- 5 Wednesday—Spring Semester Ends 12:30 p.m.
- 8 Saturday—Commencement Day

SUMMER SESSIONS 1957

JUNE 1957

- 10 Monday—Registration for Inter-Session 8 a.m. to 12 noon
- 10 Monday—Inter-Session Classes Begin 2 p.m.
- 28 Friday—Inter-Session Ends 4:50 p.m.

JULY

- 1 Monday—Registration for Main Summer Session
- 2 Tuesday—Main Summer Session Classes Begin 8 a.m.
- 4 Thursday—Independence Day Recess
- 12 Friday—Last Date for an August Graduate to Deliver Doctoral Thesis to Committee
- 19 Friday—Last Date for an August Graduate to Deliver Master's Thesis to Adviser
- 19 Friday—Last Date for Final Oral Doctoral Examination for August Graduates
- 26 Friday—Theses Due in Graduate School Office 5 p.m.
- 27 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 29 Monday—Foreign Language Examination for Doctorates

AUGUST

- 9 Friday—Main Summer Session Ends 4:50 p.m.
- 10 Saturday—Main Summer Session Graduation Exercises
- 12 Monday—Registration for Post-Session 8 a.m. to 12 noon
- 12 Monday—Post-Session Classes Begin 2 p.m.
- 30 Friday—Post-Session Ends 4:50 p.m.

FALL SEMESTER 1957

SEPTEMBER 1957

- 11-14 Wednesday to Saturday—Fall Semester Registration
- 16 Monday—Fall Semester Classes Begin 8 a.m.
- 27 Friday—Convocation of the Graduate School 7:30 p.m.
- 28 Saturday—Last Date for Students to Add Courses

OCTOBER

- 12 Saturday—Last Date for Students to Drop Courses
- 17 Thursday—Graduate Faculty Meeting 4:10 p.m.

NOVEMBER

- 4 Monday—Foreign Language Examination for Doctorates
- 21 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 27 Wednesday—Thanksgiving Recess Begins 11:50 a.m.

DECEMBER

- 2 Monday—Thanksgiving Recess Ends 8 a.m.
- 19 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 21 Saturday—Christmas Recess Begins 11:50 a.m.
- 28 Saturday—Last Date for a January Graduate to Deliver Doctoral Thesis to Committee

JANUARY 1958

- 2 Thursday—Christmas Recess Ends 1:10 p.m.
- 4 Saturday—Last Date for a January Graduate to Deliver Master's Thesis to Adviser

- 4 Saturday—Last Date for Final Oral Doctoral Examination for January Graduate
- 11 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 11 Saturday—Theses Due in Graduate School Office 12 noon
- *13 Monday—Fall Semester Classes End 5 p.m.
- 14 Tuesday—Fall Semester Examinations Begin 8 a.m.
- 22 Wednesday—Fall Semester Ends 5:30 p.m.
- 26 Sunday—Fall Semester Graduation Exercises

SPRING SEMESTER 1958

JANUARY 1958

Jan. 29- }
Feb. 1 } Wednesday to Saturday—Spring Semester Registration

FEBRUARY

- 3 Monday—Spring Semester Classes Begin 8 a.m.
- 15 Saturday—Last Date for Students to Add Courses
- 20 Thursday—Graduate Faculty Meeting 4:10 p.m.

MARCH

- 1 Saturday—Last Date for Students to Drop Courses
- 3 Monday—Foreign Language Examination for Doctorates
- 20 Thursday—Graduate Faculty Meeting 4:10 p.m.

APRIL

- 2 Wednesday—Spring Recess Begins 11:50 a.m.
- 9 Wednesday—Spring Recess Ends 1:10 p.m.
- 17 Thursday—Graduate Faculty Meeting 4:10 p.m.

MAY

- 10 Saturday—Last Date for a June Graduate to Deliver Doctoral Thesis to Committee
- 15 Thursday—Graduate Faculty Meeting 4:10 p.m.
- 17 Saturday—Last Date for a June Graduate to Deliver Master's Thesis to Adviser
- 17 Saturday—Last Date for Final Oral Doctoral Examination for June Graduates
- 24 Saturday—Spring Semester Classes End 11:50 a.m.
- 24 Saturday—Theses Due in Graduate School Office 12 noon
- 24 Saturday—Spring Semester Examinations Begin 1:10 p.m.
- 24 Saturday—Cap and Gown Fee Due 5:30 p.m.
- 30 Friday—Memorial Day Recess

JUNE

- 4 Wednesday—Spring Semester Ends 12:30 p.m.
- 7 Saturday—Commencement Day

* On Monday, January 13, the morning classes shall be according to the Thursday morning schedule; the afternoon classes shall be according to the Wednesday afternoon schedule.

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 Engineering Mechanics
 Soil Technology
 Geochemistry
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 Fuel Technology
 American History
 Physics
 Sanitary Engineering
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 Botany
 Petrology and Sedimentation
 Industrial Education
 Horticulture
 Physical Education
 Marketing
 Finance
 Psychology
 Romance Languages
 Aeronautical Engineering
 Plant Pathology
 Metallurgy
 Education
 English Literature
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 Foods and Nutrition
 Art Education
 English Composition
 Journalism
 Poultry Husbandry
 Engineering Mechanics
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 Floriculture
 Sociology
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GEORGE E. MURPHY, D.Ed. (Stanford)	<i>Education</i>
ROBERT R. MURPHY, Ph.D. (Penn State)	<i>Poultry Husbandry</i>
H. BURTON MUSSER, B.S. (Penn State)	<i>Agronomy</i>
HANS NEUBERGER, D.Sc. (Hamburg)	<i>Meteorology</i>
FRANK S. NEUSBAUM, M.A. (Penn State)	<i>Theatre Arts</i>
JOHN E. NICHOLAS, M.S. (M.I.T.)	<i>Agricultural Engineering</i>
BENJAMIN W. NIEBEL, M.S. (Penn State), I.E., P.E.	<i>Industrial Engineering</i>
RALPH F. NIELSEN, Ph.D. (Nebraska)	<i>Petroleum and Natural Gas Engineering</i>
CLARENCE I. NOLL, Ph.D. (Penn State)	<i>Chemistry</i>
NEWELL A. NORTON, Ph.D. (Michigan)	<i>Wood Utilization</i>
THOMAS S. OAKWOOD, Ph.D. (Penn State)	<i>Chemistry</i>
JOSEPH F. O'BRIEN, M.S. (Penn State)	<i>Public Speaking</i>
MARTIN L. ODLAND, Ph.D. (Minnesota)	<i>Olericulture</i>
J. HARRIS OLEWINE, Ph.D. (Penn State)	<i>Organic Chemistry</i>
ROBERT T. OLIVER, Ph.D. (Wisconsin), LL.D.	<i>Speech</i>
ELBURT F. OSBORN, Ph.D. (California Tech.)	<i>Geochemistry</i>
MILTON S. OSBORNE, M.S. (Columbia), R.A.	<i>Architecture</i>
INA PADGETT, M.S. (Columbia)	<i>Foods and Nutrition</i>
HANS A. PANOFSKY, Ph.D. (California)	<i>Meteorology</i>
ROBERT B. PATRICK, D.Ed. (Columbia)	<i>Education</i>
LOUIS F. PECK, Ph.D. (Harvard)	<i>English Composition</i>
FRANK W. PEIKERT, M.S. (Iowa State)	<i>Agricultural Engineering</i>
RAYMOND PEPINSKY, Ph.D. (Chicago)	<i>Physics</i>
LAWRENCE J. PEREZ, M.C.E. (Brooklyn Polytech.), P.E.	<i>Civil Engineering</i>
CLARE W. PIERCE, Ph.D. (Cornell)	<i>Agricultural Economics</i>
HENRY W. POPP, Ph.D. (Chicago)	<i>Botany</i>
GORDON H. PRITHAM, Ph.D. (Penn State)	<i>Physiological Chemistry</i>
ALFRED G. PUNDT, Ph.D. (Columbia)	<i>European History</i>
GILFORD G. QUARLES, Ph.D. (Virginia)	<i>Engineering Research</i>
ELMER R. QUEER, M.S. (Penn State), P.E.	<i>Engineering Research</i>
DOROTHY QUIGGLE, Ph.D. (Penn State)	<i>Chemistry and Chemical Engineering</i>
DAVID H. RANK, Ph.D. (Penn State), D.Sc.	<i>Physics</i>
WILLIAM E. RANZ, Ph.D. (Wisconsin)	<i>Engineering Research</i>
JOSEPH G. RAYBACK, Ph.D. (Western Reserve)	<i>American History</i>
HAROLD J. READ, Ph.D. (Pennsylvania), P.E.	<i>Physical Metallurgy</i>
ARTHUR H. REEDE, M.A. (Penn State), D.Sc.	<i>Economics</i>
CALVIN G. REEN, M.S.E. (Michigan), P.E.	<i>Civil Engineering</i>
JAMES J. REID, Ph.D. (Wisconsin)	<i>Bacteriology</i>
J. W. CRANE REMALEY, Ph.D. (Pittsburgh)	<i>Education</i>
LOUIS A. RICHARDSON, M.S. (Penn State), P.E.	<i>Architectural Engineering</i>
A. CHESTER RICHER, Ph.D. (Penn State)	<i>Soil Technology</i>
CHAUNCEY O. RIDENOUR, M.A. (Penn State)	<i>English Literature</i>
JOHN D. RIDGE, Ph.D. (Chicago)	<i>Mineral Economics</i>
ARTHUR ROSE, Ph.D. (Cincinnati)	<i>Chemical Engineering</i>

PROFESSORS

CHARLES J. ROWLAND, M.B.A. (Northwestern), C.P.A.	Accounting
JOSEPH J. RUBIN, Ph.D. (Yale)	American Literature
DAVID W. RUSSELL, Ph.D. (Western Reserve)	Education
JOHN A. SAUER, Ph.D. (Cambridge)	Physics
ROGER B. SAYLOR, Ph.D. (Illinois)	Business Statistics
HAROLD K. SCHILLING, Ph.D. (Iowa), D.Sc.	Physics
CLAYTON H. SCHUG, M.A. (Ohio State)	Public Speaking
PAUL H. SCHWEITZER, Dr.Ing. (Dresden), P.E.	Engineering Research
RALPH P. SEWARD, Ph.D. (Brown)	Chemistry
AMOS J. SHALER, Sc.D. (M.I.T.)	Metallurgy
WARD M. SHARP, Ph.D. (Washington U.)	Wildlife Management
ISADOR M. SHEFFER, Ph.D. (Harvard)	Mathematics
PHILIP A. SHELLEY, Ph.D. (Harvard)	German and Comparative Literature
EUGEN SKUDRZYK, Ph.D. (Berlin)	Engineering Research
ROBERT L. SLOBOD, Ph.D. (Northwestern)	Petroleum and Natural Gas Engineering
F. RAYMOND SMITH, Ph.D. (Michigan)	Physics
GRANT W. SMITH, Ph.D. (Minnesota)	Chemistry
KINSLEY R. SMITH, Ph.D. (Pennsylvania)	Psychology
WILLIAM M. SMITH, JR., Ph.D. (Cornell)	Family Relationships
WILLIAM U. SNYDER, Ph.D. (Ohio State)	Psychology
NORMAN R. SPARKS, M.E. (Clarkson)	Mechanical Engineering
CHARLES M. SPEIDEL, M.S. (Penn State)	Physical Education
HOWARD B. SPRAGUE, Ph.D. (Rutgers)	Agronomy
VANCE G. SPRAGUE, Ph.D. (Wisconsin)	Agronomy (part-time)
EARL B. STAVELY, E.E. (Penn State)	Electrical Engineering
HERBERT STEINER, Ph.D. (Zurich)	German
GLENN Z. STEVENS, Ph.D. (Minnesota)	Agricultural Education
ROBERT W. STONE, Ph.D. (Iowa State)	Bacteriology
RANDALL S. STOUT, Ph.D. (Pittsburgh)	Public Finance
EARL P. STRONG, Ed.D. (N.Y.U.)	Management
JOSEPH T. SULLIVAN, Ph.D. (Purdue)	Phytochemistry
A. BRUCE SUTHERLAND, Ph.D. (Pennsylvania)	English Literature
FRANK M. SWARTZ, Ph.D. (Johns Hopkins)	Paleontology
RAYMOND W. SWIFT, Ph.D. (Rochester)	Animal Nutrition
ROBERT W. TAFT, JR., Ph.D. (Ohio State)	Chemistry
SHELDON C. TANNER, M.A. (Utah)	Business Law
HAROLD I. TARPLEY, M.S. (Illinois), P.E.	Electrical Engineering
FLORENCE E. TAYLOR, D.Ed. (Columbia)	Elementary Education
WILLA C. TAYLOR, M.A. (N.Y.U.)	Music and Music Education
GLENN N. THIEL, M.Ed. (Penn State)	Physical Education
GEORGE L. THUERING, M.S. (Penn State), M.E., P.E.	Industrial Engineering
HARRISON M. TIETZ, Ph.D. (Massachusetts)	Anatomy and Physiology
HOWARD O. TRIEBOLD, Ph.D. (Minnesota)	Agricultural and Biological Chemistry
O. FRANK TUTTLE, Ph.D. (M.I.T.)	Geochemistry
ABRAM W. VANDERMEER, Ph.D. (Chicago)	Education
EDWARD B. VAN ORMER, Ph.D. (Columbia)	Psychology
HERBERT A. WAHL, Ph.D. (Penn State)	Botany
PHILIP L. WALKER, JR., Ph.D. (Penn State)	Fuel Technology
JOHN B. WASHKO, Ph.D. (Wisconsin)	Agronomy
R. HADLY WATERS, Ph.D. (Pennsylvania)	Transportation
ARTHUR H. WAYNICK, Sc.D. (Harvard)	Electrical Engineering
PALMER C. WEAVER, Ph.D. (Columbia)	Education
WAYNE WEBB, Ph.D. (Iowa)	Physics

PROFESSORS

ARTHUR M. WELLINGTON, M.A. (Ohio State)	<i>Counselor Education</i>
WILLIAM L. WERNER, M.A. (Penn State)	<i>American Literature</i>
CLIFFORD C. WERNHAM, Ph.D. (Cornell)	<i>Plant Pathology</i>
WOLDEMAR WEYL, Dr.Ing. (Aachen)	<i>Glass Technology</i>
RALPH H. WHERRY, M.A. (Penn State), C.L.U.	<i>Insurance</i>
BENJAMIN A. WHISLER, Sc.D. (Harvard), P.E.	<i>Civil Engineering</i>
DAVID G. WHITE, Ph.D. (Ohio State)	<i>Pomology</i>
MARSH W. WHITE, Ph.D. (Penn State)	<i>Physics</i>
WALLACE E. WHITE, Ph.D. (Yale)	<i>Wood Technology</i>
DELPHA E. WIESENDANGER, M.S. (Cornell)	<i>Home Management and Housing</i>
MARY L. WILLARD, Ph.D. (Cornell)	<i>Chemistry</i>
PAUL S. WILLIAMS, M.S. (Penn State)	<i>Dairy Production</i>
HAROLD K. WILSON, Ph.D. (Illinois)	<i>Agronomy</i>
GEORGE F. WISLICENUS, Ph.D. (California Tech.), P.E.	<i>Aeronautical Engineering</i>
HAROLD P. ZELKO, M.A. (Ohio State), LL.B.	<i>Public Speaking</i>
P. THOMAS ZIEGLER, M.S. (Penn State)	<i>Animal Husbandry</i>

ASSOCIATE PROFESSORS

EUGENE ACKERMAN, Ph.D. (Wisconsin)	<i>Physics</i>
MARY BROWN ALLGOOD, M.S. (Iowa State)	
	<i>Home Equipment and Commercial Consumer Services</i>
RALPH E. ARMINGTON, M.S. (N.Y.U.), E.E., P.E.	<i>Electrical Engineering</i>
RALPH G. ASCAH, Ph.D. (N.Y.U.)	<i>Chemistry</i>
ELTON ATWATER, Ph.D. (American U.)	<i>Political Science</i>
RAYMOND G. D. AYOUB, Ph.D. (Illinois)	<i>Mathematics</i>
FRANCIS A. BABIONE, Ph.D. (Ohio State)	<i>Marketing</i>
CARL A. BAUER, Ph.D. (Harvard)	<i>Physics</i>
SAMUEL P. BAYARD, A.M. (Harvard)	<i>English Composition</i>
KENNETH R. BEITTEL, D.Ed. (Penn State)	<i>Art Education</i>
ANDREW A. BENSON, Ph.D. (California Tech.)	<i>Agricultural and Biological Chemistry</i>
ALFRED K. BLACKADAR, Ph.D. (N.Y.U.)	<i>Meteorology</i>
JOHN S. BOYLE, Ph.D. (Wisconsin)	<i>Plant Pathology</i>
JOSEPH F. BRADLEY, Ph.D. (Pittsburgh)	<i>Finance</i>
J. NORTON BRENNAN, Ph.D. (Penn State)	<i>Engineering Research</i>
LEO A. BRESSLER, Ph.D. (Pennsylvania)	<i>English Composition</i>
JOSEPH H. BRITTON, Ph.D. (Chicago)	<i>Child Development and Family Relationships</i>
CHARLES H. BROWN, M.A. (Oklahoma)	<i>Journalism</i>
EMORY J. BROWN, Ph.D. (Michigan State)	
	<i>Rural Sociology and Agricultural Extension</i>
HUGH S. BROWN, Ph.D. (Minnesota)	<i>Higher Education</i>
IRA V. BROWN, Ph.D. (Harvard)	<i>American History</i>
ROY C. BUCK, Ph.D. (Minnesota)	<i>Rural Sociology</i>
EMIL J. BURCIK, Ph.D. (California Tech.)	<i>Petroleum and Natural Gas Engineering</i>
WILLIAM T. BUTZ, Ph.D. (Penn State)	<i>Agricultural Economics</i>
W. PAUL CAMPBELL, D.Ed. (Penn State)	<i>Music Education</i>
FLOYD L. CARNAHAN, Ph.D. (Northwestern)	<i>Chemical Engineering</i>
HOWARD L. CARNAHAN, Ph.D. (Minnesota)	<i>Agronomy</i>
ELTON S. CARTER, Ph.D. (Northwestern)	<i>Speech</i>
GEORGE E. CEIGA, B.Mus. (American Conservatory)	<i>Music</i>
STUART H. CHAMBERLAIN, M.S. (Michigan State)	<i>Engineering Research</i>
WILLIAM V. CHANDLER, Ph.D. (Ohio State)	<i>Agronomy</i>
TIEN-HSI CHENG, Ph.D. (Ohio State)	<i>Zoology</i>

ASSOCIATE PROFESSORS

MICHAEL CHIAPPETTA, Ph.D. (Michigan)	Education
HENRY H. CHISMAN, M.F. (Duke)	Forestry
RALPH W. CONDEE, Ph.D. (Illinois)	English Literature
RAY M. CONGER, M.S. (Iowa State)	Physical Education
CLYDE G. CORLE, D.Ed. (Cincinnati)	Education
JOHN F. CORSO, Ph.D. (Iowa)	Psychology
WALTER J. DELACY, D.Ed. (Buffalo)	Educational Administration
NORMAN G. DENO, Ph.D. (Ohio State)	Chemistry
JOHN A. DENOVO, Ph.D. (Yale)	American History
CHARLES C. DILLIO, M.S. (Penn State), P.E.	Mechanical Engineering
JOSEPH A. DIXON, Ph.D. (Penn State)	Chemistry
JAMES W. DUNLOP, M.Mus. (Michigan)	Music Education
ARTHUR W. EINSTEIN, M.S.E. (Michigan)	Marketing and Retailing
JULIAN EISENSTEIN, Ph.D. (Harvard)	Physics
CHARLES L. FERGUS, Ph.D. (Penn State)	Botany and Plant Pathology
ILINE FIFE, Ph.D. (Louisiana State)	Speech
HARRY C. FINK, Ph.D. (Iowa State)	Plant Pathology
KATHERINE H. FISHER, Ph.D. (Penn State)	Foods and Nutrition
EDWIN R. FITZGERALD, Ph.D. (Wisconsin)	Physics
ROBERT J. FLIPSE, Ph.D. (Michigan State)	Dairy Science
HENRY R. FORTMANN, Ph.D. (Cornell)	Agronomy
LAWRENCE E. FOURAKER, Ph.D. (Colorado)	Economics
JOHN C. FREY, Ph.D. (Iowa State)	Land Economics
JAMES V. FRICK, Ph.D. (Iowa)	Speech
ALINE H. FRINK, Ph.D. (Chicago)	Mathematics
JAMES J. FRITZ, Ph.D. (California)	Chemistry
MARY E. FUQUA, Ph.D. (Ohio State)	Foods and Nutrition
HELEN S. GALBRAITH, M.A. (Penn State)	Art
ROBERT F. GENTRY, Ph.D. (Michigan State)	Veterinary Science
LEON GORLOW, Ph.D. (Columbia)	Psychology
JOSEPH H. GRAHAM, Ph.D. (North Carolina State)	Plant Pathology
ELMER A. GROSS, D.Ed. (Pittsburgh)	Physical Education
JOSEPH H. GROSSLIGHT, Ph.D. (Yale)	Psychology
ALVIN R. GROVE, JR., Ph.D. (Chicago)	Botany
GEORGE M. GUTHRIE, Ph.D. (Minnesota)	Psychology
EDGAR B. HALE, Ph.D. (Chicago)	Animal Behavior
JOHN F. HALL, Ph.D. (Ohio State)	Psychology
DONALD E. HARDENBERGH, M.S. (Penn State)	Engineering Mechanics
WALTER J. HARRINGTON, Ph.D. (Cornell)	Mathematics
JOHN R. HAYES, Ph.D. (Penn State)	Chemistry
CARROLL E. HEIST, Ph.D. (Illinois)	Bacteriology
WILLIAM M. HENCH, Ph.D. (Pennsylvania)	International Trade
RODNEY E. HERSH, M.S. (Penn State)	Chemical Engineering
E. ELIZABETH HESTER, Ph.D. (Cornell)	Foods and Nutrition
ELIZABETH C. HILLIER, Ph.D. (Ohio State)	Home Economics Education
CLIFFORD B. HOLT, JR., M.S. (Penn State), P.E.	Electrical Engineering
ALBERT H. HOLTZINGER, Ph.D. (Penn State)	Chemistry
CHARLES L. HOSLER, JR., Ph.D. (Penn State)	Meteorology
L. AILEEN HOSTINSKY, Ph.D. (Illinois)	Mathematics
LING-WEN HU, Ph.D. (Penn State)	Engineering Mechanics
FLOYD A. HUMMEL, M.S. (Penn State)	Ceramic Technology
HARRY K. HUTTON, D.Ed. (Penn State)	Education
ROBERT F. HUTTON, Ph.D. (Harvard)	Farm Management

ASSOCIATE PROFESSORS

FRANCIS E. HYSLOP, JR., M.F.A. (Princeton)	<i>History of Art and Architecture</i>
LOIS B. HYSLOP, Ph.D. (Wisconsin)	<i>Romance Languages</i>
HENRY W. JOHNSTONE, JR., Ph.D. (Harvard)	<i>Philosophy</i>
JENNINGS H. JONES, Ph.D. (Penn State)	<i>Chemistry</i>
THEODORE K. KARHAN, M.Ed. (Penn State)	<i>Music and Music Education</i>
JACOB J. KAUFMAN, Ph.D. (Columbia)	<i>Economics</i>
EARL M. KESLER, Ph.D. (Penn State)	<i>Dairy Science</i>
JOHN R. KINNEY, Ph.D. (Illinois)	<i>Mathematics</i>
E. ERWIN KLAUS, Ph.D. (Penn State)	<i>Petroleum Chemistry</i>
LEON R. KNEEBONE, Ph.D. (Penn State)	<i>Botany</i>
ARTHUR O. LEWIS, JR., Ph.D. (Penn State)	<i>English Literature</i>
A. PAULINE LOCKLIN, M.A. (Illinois)	<i>English Literature</i>
MILDRED A. LUCEY, Ph.D. (N.Y.U.)	<i>Physical Education</i>
M. FRANK MALLETTE, Ph.D. (Columbia)	<i>Agricultural and Biological Chemistry</i>
E. ORTH MALOTT, Ph.D. (Northwestern)	<i>Finance</i>
VACLAV MARES, Ph.D. (Charles University, Prague)	<i>Economics</i>
SULLIVAN S. MARSDEN, JR., Ph.D. (Stanford)	<i>Petroleum and Natural Gas Engineering</i>
CHARLES R. MARSH, M.S. (Illinois)	<i>Electrical Engineering</i>
WILLIAM H. MARTIN, Ph.D. (Harvard)	<i>Economics</i>
WILL E. MASON, Ph.D. (Princeton)	<i>Economics</i>
EDWARD L. MATTIL, D.Ed. (Penn State)	<i>Art Education</i>
ROBERT H. MCCORMICK, M.S. (Penn State)	<i>Chemical Engineering</i>
EVERETT R. McLAUGHLIN, M.S. (Penn State), P.E.	<i>Engineering Research</i>
NEIL A. McNALL, Ph.D. (Cornell)	<i>American History</i>
MORRIS MENDELSON, Ph.D. (Cornell)	<i>Economics</i>
WARREN W. MILLER, Ph.D. (California)	<i>Chemistry</i>
JEANETTE MOLLOY, M.A. (Columbia)	<i>Elementary Education (part-time)</i>
J. HERBERT MOORE, M.S. (Penn State), P.E.	<i>Civil Engineering</i>
ROBERT K. MURRAY, Ph.D. (Ohio State)	<i>History</i>
EUGENE A. MYERS, Ph.D. (Pittsburgh)	<i>Economics</i>
VERNON W. MYERS, Ph.D. (Yale)	<i>Physics</i>
WILLIAM T. NEARN, D.For. (Yale)	<i>Wood Utilization</i>
G. KENNETH NELSON, Ph.D. (Illinois), C.P.A.	<i>Accounting</i>
HAROLD E. NELSON, Ph.D. (Iowa)	<i>Speech</i>
MARGARET A. NEUBER, M.A. (Columbia)	<i>Special Education</i>
PAUL F. NORTON, Ph.D. (Princeton)	<i>History of Art and Architecture</i>
EDWIN P. NYE, M.S. (Harvard), P.E.	<i>Mechanical Engineering</i>
GILMA M. OLSON, M.S. (Minnesota)	<i>Foods and Nutrition</i>
GEORGE U. OPPEL, Dr.Ing. (Technical University, Munich)	<i>Engineering Mechanics</i>
LESLIE M. PAPE, Ph.D. (Chicago)	<i>Philosophy</i>
LAWRENCE PARK, Ed.D. (N.Y.U.)	<i>Elementary Education</i>
JEROME K. PASTO, Ph.D. (Cornell)	<i>Farm Management</i>
STUART PATTON, Ph.D. (Ohio State)	<i>Dairy Science</i>
NORMAN C. PENDERED, D.Ed. (Penn State)	<i>Industrial Arts Education</i>
RUTH L. PIKE, Ph.D. (Chicago)	<i>Foods and Nutrition</i>
T. R. PORTER, Ph.D. (California)	<i>Education</i>
WILLIAM S. RAY, Ph.D. (Maryland)	<i>Psychology</i>
ROBERT R. REED, JR., Ph.D. (Columbia)	<i>English Composition</i>
ROBERT D. REIFSNEIDER, M.A. (Michigan)	<i>Theatre Arts</i>
NEAL RIEMER, Ph.D. (Harvard)	<i>Political Science</i>
H. DAVID RIX, Ph.D. (Princeton)	<i>Physics</i>
ALLAN L. RODGERS, Ph.D. (Wisconsin)	<i>Geography</i>
LÉON S. ROUDIEZ, Ph.D. (Columbia)	<i>Romance Languages</i>

ASSOCIATE PROFESSORS

RUSTUM ROY, Ph.D. (Penn State)	<i>Geochemistry</i>
CHARLES W. RUTSCHKY, Ph.D. (Cornell)	<i>Entomology</i>
CHRISTINE F. SALMON, M.Arch. (Pennsylvania), R.A.	<i>Housing and Home Art</i>
F. CUTHBERT SALMON, M.Arch. (Pennsylvania), R.A.	<i>Architecture</i>
JOHN M. SCHEMPF, Ph.D. (Cornell)	<i>Chemistry</i>
MARY P. SHELTON, Ed.D. (Columbia)	<i>Clothing and Textiles Research</i>
PAUL E. SHIELDS, M.S. (Pittsburgh), E.E., P.E.	<i>Electrical Engineering</i>
SAMUEL SHULITS, M.S. (Michigan College of Mining and Technology)	<i>Civil Engineering</i>
SIDNEY SIEGEL, Ph.D. (Stanford)	<i>Psychology</i>
BRUCE M. SIEGENTHALER, Ph.D. (Michigan)	<i>Clinical Speech</i>
RUTH C. SILVA, Ph.D. (Michigan)	<i>Political Science</i>
CYRIL B. SMITH, Ph.D. (Penn State)	<i>Plant Nutrition</i>
WARREN S. SMITH, M.A. (Iowa)	<i>Theatre Arts</i>
LEO H. SOMMER, Ph.D. (Penn State)	<i>Chemistry</i>
WILLIAM SPACKMAN, JR., Ph.D. (Harvard)	<i>Paleobotany</i>
F. BRISCOE STEPHENS, Ph.D. (Penn State)	<i>Meteorology</i>
RICHARD G. STONER, Ph.D. (Princeton)	<i>Physics</i>
WERNER F. STRIEDIECK, Ph.D. (Michigan)	<i>German</i>
SHIOU-CHUAN SUN, Sc.D. (M.I.T.)	<i>Mineral Preparation</i>
DENO G. THEVAOS, Ed.D. (Columbia)	<i>Psychology</i>
DOROTHY H. VEON, Ed.D. (Columbia)	<i>Business Education</i>
ROBERT K. VIERCK, M.S. (Iowa), P.E.	<i>Engineering Mechanics</i>
WALTER H. WALTERS, Ph.D. (Western Reserve)	<i>Theatre Arts</i>
THOMAS WARTIK, Ph.D. (Chicago)	<i>Chemistry</i>
GEORGE H. WATROUS, JR., Ph.D. (Penn State)	<i>Dairy Manufacturing</i>
ROBERT L. WEBER, Ph.D. (Penn State)	<i>Physics</i>
MERRILL WOOD, M.S. (Penn State)	<i>Zoology</i>
SAMUEL M. WOOLSEY, Ph.D. (Texas), C.P.A.	<i>Accounting</i>
JAMES E. WRIGHT, Ph.D. (Cornell)	<i>Genetics</i>
KELLY YEATON, M.A. (Washington)	<i>Theatre Arts</i>
LEONARD N. ZIMMERMAN, Ph.D. (Cornell)	<i>Bacteriology</i>
HARRY D. ZOOK, Ph.D. (Penn State)	<i>Chemistry</i>

ASSISTANT PROFESSORS

ADAM ANTHONY, Ph.D. (Chicago)	<i>Zoology</i>
GALIP M. ARKILIC, Ph.D. (Northwestern)	<i>Engineering Mechanics</i>
VERNON ASPATURIAN, Ph.D. (U.C.L.A.)	<i>Political Science</i>
JAMES B. BARTOO, Ph.D. (Iowa)	<i>Mathematics</i>
RONALD A. BARTOO, M.F. (Yale)	<i>Forestry</i>
ROBERT V. BAUER, Ph.D. (Illinois)	<i>English Literature</i>
SIMON BELASCO, Ph.D. (Pennsylvania)	<i>Romance Languages</i>
ASA J. BERLIN, Ph.D. (Northwestern)	<i>Speech Education</i>
LUTHER T. BISSEY, M.S. (Penn State)	<i>Petroleum and Natural Gas Engineering</i>
CONVERSE H. BLANCHARD, Ph.D. (Wisconsin)	<i>Physics</i>
DONALD W. BLEZNICK, Ph.D. (Columbia)	<i>Romance Languages</i>
B. PETER BLOCK, Ph.D. (Illinois)	<i>Chemistry</i>
JAMES R. BLOOM, Ph.D. (Wisconsin)	<i>Plant Pathology</i>
GERALD BOSCH, Ph.D. (Michigan State)	<i>Elementary Education</i>
SIDNEY A. BOWHILL, Ph.D. (Cambridge)	<i>Electrical Engineering</i>
NICHOLAS M. BRENTIN, M.A. (Penn State)	<i>Romance Languages</i>
BARRY S. BRINSMAID, M.A. (Columbia)	<i>Music</i>

ROBERT S. BRUBAKER, Ph.D. (Illinois)	<i>Speech</i>
CLYDE R. BURNETT, Ph.D. (Wisconsin)	<i>Physics</i>
C. WAYNE BURNHAM, Ph.D. (California Tech.)	<i>Economic Geology</i>
H. BRUCE BYLUND, Ph.D. (Penn State)	<i>Rural Sociology</i>
HUGH H. CHAPMAN, JR., Ph.D. (Harvard)	<i>Romance Languages</i>
ROBERT N. CLAYTON, Ph.D. (California Tech.)	<i>Geochemistry</i>
RICHARD W. CLEVELAND, Ph.D. (California)	<i>Agronomy</i>
WILLIAM E. COBB, D.Ed. (Penn State)	<i>Education</i>
H. TREVOR COLBOURN, Ph.D. (Johns Hopkins)	<i>History</i>
JOSEPH J. COMER, M.S. (Penn State)	<i>Mineral Sciences</i>
HOUSTON B. COUCH, Ph.D. (California)	<i>Plant Pathology</i>
WILLIAM CRAIG, Ph.D. (Harvard)	<i>Mathematics</i>
LLOYD A. CURRIE, Ph.D. (Chicago)	<i>Chemistry</i>
HOLLE G. DEBOER, M.A. (Colorado State College of Education)	<i>Public Speaking</i>
JOHN A. FITZ, D.Ed. (Denver)	<i>Education</i>
FREDERICK C. FLIEGEL, Ph.D. (Wisconsin)	<i>Rural Sociology</i>
MALCOLM FREIBERG, Ph.D. (Brown)	<i>History</i>
GEORGE J. FRITZ, Ph.D. (Purdue)	<i>Botany</i>
RICHARD E. GLICK, Ph.D. (California)	<i>Chemistry</i>
LIONEL GOODMAN, Ph.D. (Iowa State)	<i>Chemistry</i>
ROBERT W. GREEN, Ph.D. (Iowa)	<i>History</i>
PHYLLIS R. GRIESS, Ph.D. (Penn State)	<i>Geography</i>
PAUL GRUN, Ph.D. (Cornell)	<i>Genetics</i>
CHARLES G. HAAS, JR., Ph.D. (Chicago)	<i>Chemistry</i>
ROBERT I. HARKER, Ph.D. (Cambridge)	<i>Geochemistry</i>
GEORGE R. HUDSON, Ed.D. (Columbia)	<i>Education</i>
LYMAN C. HUNT, JR., D.Ed. (Syracuse)	<i>Education</i>
BERNARD R. JERMAN, Ph.D. (Ohio State)	<i>English Literature</i>
FRANCO P. JONA, Ph.D. (Zurich)	<i>Physics</i>
RICHARD N. JONES, Ph.D. (Penn State)	<i>Farm Mechanics</i>
JOSEPH JORDAN, Ph.D. (Hebrew University, Jerusalem)	<i>Chemistry</i>
RICHARD N. JORGENSEN, D.For. (Yale)	<i>Wood Technology</i>
PHILIP G. KEENEY, Ph.D. (Penn State)	<i>Dairy Science</i>
BORIS J. KOCHANOWSKY, Dr.Ing. (Clausthal)	<i>Mining Engineering</i>
ANTON J. KOVAR, Ph.D. (Rome)	<i>Botany</i>
DONALD T. LAIRD, Ph.D. (Penn State)	<i>Electrical Engineering</i>
JOSEPH T. LAW, M.A. (Wisconsin)	<i>Political Science</i>
EUGENE S. LINDSTROM, Ph.D. (Wisconsin)	<i>Bacteriology</i>
HAROLD L. LOVELL, Ph.D. (Penn State)	<i>Mineral Sciences</i>
ROBERT H. McALEXANDER, Ph.D. (Iowa State)	<i>Farm Management</i>
MALCOLM C. McQUARRIE, Sc.D. (M.I.T.)	<i>Ceramic Technology</i>
DONALD F. MITCHELL, Ph.D. (U.C.L.A.)	<i>Genetics</i>
E. JAMES MOORE, Ph.D. (Michigan)	<i>Geophysics</i>
J. MITCHELL MORSE, Ph.D. (Penn State)	<i>English Composition</i>
GERALD M. MOSER, D.U.P. (Paris)	<i>Romance Languages</i>
ARNULF I. MUAN, Ph.D. (Penn State)	<i>Metallurgy</i>
WERNER J. MUELLER, Dr.Sc.Tech. (Swiss Fed. Inst. of Tech.)	<i>Poultry Husbandry</i>
JOHN B. NESBITT, Sc.D. (M.I.T.)	<i>Civil Engineering</i>
RICHARD P. NICKELSEN, Ph.D. (Johns Hopkins)	<i>Geology</i>
FRANCENA L. NOLAN, Ph.D. (Penn State)	<i>Home Management and Rural Sociology</i>
WILLIAM J. PAGE, Ed.D. (Temple)	<i>Education</i>
HOWARD B. PALMER, Ph.D. (Wisconsin)	<i>Fuel Technology</i>
THEODORE S. POLANSKY, Ph.D. (Penn State)	<i>Fuel Technology</i>

ASSISTANT PROFESSORS

BERNARD L. POLLACK, Ph.D. (Penn State)	<i>Plant Breeding</i>
WILLIAM W. PRATT, Ph.D. (Iowa State)	<i>Physics</i>
MARGARET C. RAABE, M.S. (Penn State)	<i>Clinical Speech and Speech Education</i>
GUY E. RINDONE, Ph.D. (Penn State)	<i>Ceramic Technology</i>
C. MARSHALL RITTER, Ph.D. (Ohio State)	<i>Pomology</i>
WILLIAM J. ROSS, Ph.D. (New Zealand)	<i>Electrical Engineering</i>
DONALD P. SATCHELL, Ph.D. (North Carolina State)	<i>Soil Technology</i>
JOHN J. SCHANZ, JR., Ph.D. (Penn State)	<i>Mineral Economics</i>
MARTIN W. SCHEIN, Sc.D. (Johns Hopkins)	<i>Animal Behavior</i>
RICHARD D. SCHEIN, Ph.D. (California)	<i>Plant Pathology</i>
ROBERT SCHOLTEN, Ph.D. (Michigan)	<i>Petroleum Geology</i>
MAURICE SHAMMA, Ph.D. (Wisconsin)	<i>Chemistry</i>
JAMES W. SHIGLEY, Ph.D. (Penn State)	<i>Agricultural and Biological Chemistry</i>
ALBERTA E. SIEGEL, Ph.D. (Stanford)	<i>Child Development and Family Relationships</i>
PHILIP S. SKELL, Ph.D. (Duke)	<i>Chemistry</i>
ALEX J. SLIVINSKE, Ph.D. (Virginia)	<i>Psychology</i>
THOMAS SMYTH, JR., Ph.D. (Johns Hopkins)	<i>Entomology</i>
FRANCIS J. SORAUF, Ph.D. (Wisconsin)	<i>Political Science</i>
C. DREW STAHL, Ph.D. (Penn State)	<i>Petroleum and Natural Gas Engineering</i>
WILLIAM A. STEELE, Ph.D. (Washington)	<i>Chemistry</i>
H. TRACY STURCKEN, Ph.D. (North Carolina)	<i>Romance Languages</i>
ALAN W. TAYLOR, Ph.D. (London)	<i>Ceramic Technology</i>
EDWARD C. THADEN, D.U.P. (Paris)	<i>History</i>
FRANK B. THOMAS, Ph.D. (Penn State)	<i>Horticulture</i>
CHARLES P. THORNTON, Ph.D. (Yale)	<i>Petrography</i>
GERALD M. TORKELSON, D.Ed. (Penn State)	<i>Visual Education</i>
LOREN D. TUKEY, Ph.D. (Ohio State)	<i>Pomology</i>
J. BRUCE WAGNER, JR., Ph.D. (Virginia)	<i>Metallurgy</i>
DARRELL E. WALKER, Ph.D. (California)	<i>Plant Breeding</i>
FRANCIS L. WHALEY, Ph.D. (Michigan)	<i>Psychology</i>
THOMAS A. WIGGINS, Ph.D. (Penn State)	<i>Physics</i>
SAMUEL F. WILL, JR., Ph.D. (Yale)	<i>Classical Languages</i>
ROLF G. WINTER, D.Sc. (Carnegie Tech.)	<i>Physics</i>
WILLIAM G. WOOD, Ph.D. (Leeds)	<i>Engineering Mechanics</i>
ARTHUR E. WOODWARD, Ph.D. (Brooklyn Polytech.)	<i>Chemistry</i>
HAROLD D. WRIGHT, Ph.D. (Columbia)	<i>Mineralogy</i>
GEORGE J. YOUNG, Ph.D. (Lehigh)	<i>Fuel Technology</i>
C. COURSON ZELIFF, Ph.D. (Cornell)	<i>Zoology</i>
GEORGE S. ZORETICH, M.A. (Penn State)	<i>Art</i>

OTHER MEMBERS OF THE GRADUATE FACULTY

EDWARD ABRAMSON, A.M. (Pennsylvania)	<i>Sociology</i>
JOSEPH ALESSANDRO, D.Ed. (Penn State)	<i>Education</i>
CHRISTINE W. AYOUB, Ph.D. (Yale)	<i>Mathematics</i>
FLORINDO V. CERRETA, Ph.D. (Columbia)	<i>Romance Languages</i>
TORMOD FORLAND, M.S. (Technical University, Norway)	<i>Ceramic Technology</i>
LESLIE P. GREENHILL, B.Econ. (Melbourne)	<i>Instructional Research Program</i>
ROBERT W. HOUSE, M.S. (Ohio U.)	<i>Electrical Engineering</i>
GERHARD O. W. KREMP, Dr.rer.nat. (Posen)	<i>Geology</i>
N. W. McLACHLAN, D.Sc. (London)	<i>Electrical Engineering (Visiting)</i>
RAJJESHWAR MITTRA, M.Sc. (Calcutta)	<i>Electrical Engineering (Visiting)</i>
AMOS E. NEYHART, M.S. (Penn State)	<i>Institute of Public Safety</i>

GENERAL INFORMATION

GRADUATE WORK at The Pennsylvania State University was first offered in 1862 when two graduate students were in residence. It was given more formal recognition in 1864 by the establishment of a "course for Graduates" designed for students who, after receiving the degree of Bachelor of Scientific Agriculture, wished to do advanced work leading to the degree of Master of Scientific Agriculture. For some time there were few graduate students, and graduate instruction was relatively unorganized. Later a committee of the University Senate was given the responsibility of establishing standards and regulations governing graduate work and the granting of advanced degrees. The Graduate School was organized in 1922. Until this time only masters' degrees and certain technical degrees had been conferred. In 1924, upon recommendation of the Graduate School, the Board of Trustees authorized the granting of the degree of Doctor of Philosophy. Still later other degrees were approved.

The faculty of the Graduate School consists of the President and certain other general administrative officers of the University, the Deans, the University Examiner, the Librarian, the heads of departments, and those members of the instructional staff who have been authorized by the proper agencies of the Graduate School to offer graduate courses and supervise research leading to theses. It controls all academic matters pertaining to the Graduate School, subject to review by the University Senate.

The graduate faculty numbers approximately 600 members. Graduate student enrollment was about 1900 per semester in 1955-56 and about 2200 during the summer of 1956. The number of advanced degrees conferred in 1955-56 was 704, of which 149 were doctors' degrees.

An applicant for admission to the Graduate School should understand that graduate work is not an extension of undergraduate work. It operates at a definitely higher level, demands scholarship of a high order, and emphasizes research and creativity. It involves a minimum of formal requirements and regulations, and a maximum of student initiative and responsibility.

A student is expected to assume full responsibility for knowing the regulations and pertinent procedures of the Graduate School (as set forth in the *Graduate School Announcement* and in the *Manual for Graduate Students*) and for meeting the standards and requirements expressed by these regulations. The *Manual*, which is available to a student after he has been admitted, sets forth in more detail the general regulations outlined in the *Announcement* and furnishes other information about the Graduate School which is useful to graduate students. Every student should secure a copy of this manual from the Dean's Office as soon after admission as possible.

PROCEDURES AND REGULATIONS

ADMISSION—A student does not become a graduate student merely by enrolling for advanced courses after having received a baccalaureate degree. Formal admission to the Graduate School is required. Credits earned before admission cannot be applied to meet degree requirements at a later date even though admission may have been granted in the meantime.

Admission to the Graduate School is granted by the Dean of Admissions after approval of the application for admission by the department in which the student

ADMISSION

plans to do his major work. Blanks to be used in making formal application for admission can be obtained from the Dean of Admissions. With his application each student should present the names of two persons to whom departments may write, and who are well qualified to evaluate his abilities for graduate work in the field of his choice.

For unqualified admission to the Graduate School an applicant must have received a baccalaureate degree from an accredited institution, earned under residence and credit conditions substantially equivalent to those required by The Pennsylvania State University. He must have maintained during his junior and senior years a minimum grade point average equivalent to 2.5 on The Pennsylvania State University grading scale (equivalent to half B and half C for courses carrying the same number of credits). Finally, he must ordinarily have completed in a satisfactory manner a certain minimum of course work in designated areas, the specific courses and amount of required work depending upon the field of advanced study which the student proposes to enter. The minimum grade point average of 2.5 during the last two undergraduate years is a general requirement of the Graduate School. Individual departments may require a higher average for admission to advanced study in their fields.

Upon recommendation of a major department, conditional admission may be granted to an applicant whose undergraduate grade point average is below 2.5 but whose qualifications in other respects seem to suggest probable success in the Graduate School. Such an applicant must realize that the initiative rests entirely with him in communicating with the department of his chosen major and that, if admitted conditionally, he does graduate work at his own risk. There is no assurance that he will subsequently be granted unqualified admission or that the credits earned will automatically be applied toward degree requirements.

An applicant for admission should provide complete credentials, in duplicate, sent directly from other institutions to the Dean of Admissions at least six weeks prior to the opening of the session in which he plans to begin his graduate program. If the applicant has attended more than one institution, two official transcripts of the work covered at each institution are required. This applies to the complete academic record, both undergraduate and graduate.

If complete credentials are not available at the time of registration, this does not necessarily mean that the application for admission will be refused. However, it does mean that the applicant will be admitted only on a provisional basis pending receipt of his official credentials. The provisional admission will be subject to cancellation if the credentials, on their arrival, do not meet all the requirements for admission to the Graduate School. Also, certification of any scheduled credits while the applicant is holding provisional admission will be withheld until receipt of his official credentials makes possible his permanent admission to the Graduate School. If the provisional admission should, for any reason, be canceled, the student is thereby automatically dropped from the Graduate School and as a consequence will be required to cease attending any 500 level courses for which he may have registered. He may continue to attend 400 level courses provided he applies for and is accepted for registration as a special student.

An applicant for admission who has done considerable high quality graduate work in a graduate school known to maintain high standards will be considered on the basis of his entire record. Prospective students may write directly to the head of any department concerning graduate work in that specific field.

Foreign students are encouraged to write to the Director of Foreign Student Affairs for information concerning financial matters, housing, and other nonacademic problems.

Formal readmission is not required year by year nor after one or more semesters of absence from the campus unless the student has completed more than 12 credits of work at another institution in the meantime. In this case readmission is required, and evidence of good standing at the institution involved is essential. A student who has earned a master's degree at The Pennsylvania State University should not register for further degree work until his academic record and personal qualifications have been reviewed critically by the department of his major interest and a candidacy evaluation has been completed.

The President of the University, on recommendation of the Dean of the Graduate School, will welcome doctors of philosophy of The Pennsylvania State University, as well as those of other accredited colleges and universities, as guests of the University, with the privilege of attending seminars and courses and of carrying on research in laboratories and libraries. There will be no charge except for laboratory expenses. Arrangements should be made in advance with the Dean of the Graduate School.

A senior student of The Pennsylvania State University lacking not more than 4 credits for graduation may be admitted to the Graduate School. This limit of 4 credits may be increased to 8 in the case of a student with an average of at least B (a grade point average of 3). Other senior students, while not admitted to the Graduate School, may, if their records are superior, be admitted to graduate courses (500 series) upon the approval of the instructor of the course to which the student desires admission, and of the Dean of the Graduate School.

CLASSIFICATION—At the time of admission to the University, students are classified as graduate, special, or undergraduate students, depending upon their objectives and qualifications.

A special student is not a graduate student, inasmuch as he has not been admitted to the Graduate School, and may not register for graduate courses or research (500 and 600 series) without permission of the Dean of the Graduate School. Special students may register for 400 level courses, provided they have attained at least junior standing in college. Except for most unusual reasons, special students who are later admitted to the Graduate School may not then count toward degree requirements any credits that have been earned by them while in the special student status.

Upon admission all graduate students are classified either as regular graduate students or as general graduate students. The essential difference between the two groups is that a regular graduate student is working toward an advanced degree at The Pennsylvania State University while a general graduate student is not. Regardless of classification, all students, upon admission to the Graduate School, must register through the Graduate Dean's office for all work taken, whether or not that work is to be credited toward the requirements for a degree.

Changes in classification are arranged through the University Examiner and, in the case of a change from general to regular status, the approval of the head of the major department in which the student proposes to work is required.

Regular graduate students include those persons who plan to become candidates for degrees at The Pennsylvania State University and who have been formally admitted by the University Examiner for advanced study in a particular field. The program of study is developed under the guidance of a department head or his representative. A graduate student who plans to be a candidate for an advanced degree should enroll as a regular graduate student.

It should be emphasized that a student is not a "regular graduate student" unless he has been officially admitted to that status. Regular attendance in the Grad-

REGISTRATION

uate School, or personal plans for future degree candidacy, do not in themselves carry with them the status or privileges of a regular graduate student.

A regular graduate student who has passed a candidacy evaluation is classified as a doctoral candidate.

An applicant who meets all requirements for admission to the Graduate School, but who does not wish to work for an advanced degree at this institution, may arrange for a program of work as a general graduate student. This classification includes those who plan to transfer credits to another institution or those who plan to follow a special program of study for the fulfillment of requirements other than those for advanced degrees.

The Dean of the Graduate School appoints the adviser for a general graduate student.

The status and standing of a general graduate student will be reviewed by the Dean each time he registers. He may not remain a general graduate student longer than one semester (or summer sessions totaling 12 weeks) except with the permission of the Dean, and for definite and good reasons.

When a general graduate student wishes to become a regular graduate student—i.e., to work for an advanced degree at this institution—he should make application to the University Examiner for change of status. His undergraduate record will then be re-evaluated to determine whether or not he is prepared to undertake graduate work for a degree in the major field of his choice. He should understand that he may thereafter apply toward degree requirements only those credits earned as a general graduate student which fit definitely and logically into an integrated degree program. There is no upper limit to the number of credits that may be so applied; neither is there any guarantee that any such credits may be applicable.

REGISTRATION—A student is required to register for each semester and each summer session in which he proposes to do either course work or research, either on or off campus, except that a candidate who has met the minimum credit requirements for his degree is required to register further only for course work, project work, and for research work which requires the use of University facilities and supplies (laboratory, library, etc.). In the case of research, the number of credits shall be determined by the amount of time required for the investigation, one credit representing one week of full-time graduate work. This means, for instance, that if a student has completed three years of work (90 credits) of a doctoral program, has completed his research on campus, and has permission from the Dean to complete his work off campus, he need not register for credits. Similarly, a student who has earned 90 credits, but who still has much research to do, which does *not* involve using University facilities, and who receives permission to complete his work at, say, the Library of Congress, need not register. On the other hand, a student who uses University facilities for all his research must be registered for credit at all times, regardless of the number of credits that may accrue before he completes his work.

A candidate need not register during the semester in which he is to be graduated if he has met earlier all requirements for the degree with the exception of his final examination.

A resident student is required to register in person, not by proxy. A nonresident student is expected to assume responsibility for initiating the registration process but the details can be handled by mail. A student must register for courses audited as well as courses taken for credit.

For each registration the student, in consultation with his adviser, prepares a schedule of courses and research designed to fit his individual needs, which is then

submitted to the Dean of the Graduate School for his approval. The registration process is then completed in the manner specified for all students at the University.

Under certain conditions credit may be earned by work done off the campus. A student contemplating such work should inquire of the Dean of the Graduate School about the procedures and conditions. Such work must be scheduled *in advance* in the regular manner.

Registration dates are given in the University Calendar and a fee is assessed for the privilege of late registration. In any case, registration must be completed within the first two weeks of a semester or within the first one-sixth of any summer session. All changes of schedule must also be completed within this period, except that a student may drop a course at any time within the first four weeks of a semester. A student who is granted permission to register after the beginning of classes will, in general, be required to take a reduced load.

AUDITING AND VISITING CLASSES—A regularly registered graduate student who wishes to take a course without credit may be allowed to do so upon securing the permission of the instructor in the course and the approval of the Dean of the Graduate School. Such a student, known as an auditor, may, if he wishes, participate in class discussion, do practicum work, submit written work, and take examinations. He must register for the course in the same manner as if he were taking the course for credit and must pay fees on the same basis. He receives no grade in the course and cannot subsequently claim any sort of credit for work done in the course.

Normally, a student is required to count the courses audited as a part of his normal graduate load. However, a student who has demonstrated his ability to do superior work while carrying a normal graduate program (as determined by his status as a full-time student, or as a part-time student employed on the campus or elsewhere) may, with the approval of the Dean, register for audits in addition to his normal credit load. To secure such approval the student should present to the Dean written evidence that the instructor of the "audit course" will accept him as an auditor, and that his adviser and the head of the department employing him (if any) approve of the extra load.

A regularly registered student of the Graduate School may at any time during a regular semester visit, with the permission of the instructor, a class for which he is not registered. During summer sessions he must also obtain the permission of the Director of Summer Sessions. Under this provision the student may not claim the usual privileges of class membership, such as participating in class discussion, doing practicum work, submitting written work, and taking examinations. This privilege is officially designated as "visiting classes without registration."

ACADEMIC LOAD—A full-time student is one who devotes "all" his time to studies and/or research, and very little, if any, time to work for financial compensation. The normal maximum full-time credit load is 15 credits per semester, or 1 credit per week in shorter terms such as summer sessions. Larger loads may be scheduled very rarely and only with the approval of the Dean of the Graduate School. Ordinarily a student employed for more than a few hours per week may not register for 15 credits per semester, or 1 credit per week.

The University takes the position that the facilities of the Graduate School should be made available only to the student who can profit from his graduate school experience to a maximum extent. Therefore the Graduate School reserves the right to deny admission or registration to part-time students who (a) propose schedules of few credits which seem to reflect little real interest in graduate work or would not seem to require serious effort, or (b) wish to carry overloads of such proportions as to handicap them seriously in achieving maximum quality in their graduate work.

GRADING SYSTEM

A part-time student who is a graduate assistant or an employee of the University is governed by the following load schedules:

EMPLOYMENT OR SERVICE LOAD		CREDIT LOAD ALLOWED	
<i>Hours per Week</i>	<i>Fraction of Full Time</i>	<i>Credits</i>	<i>Fraction of Full Load</i>
0	0	15	5/5
10	1/4	11-13	4/5
20	2/4	8-10	3/5
30	3/4	6- 8	1/2
40	4/4	6	2/5

The considerations leading to the establishment of this "protective" schedule of permitted loads for assistants and employees apply equally to part-time students employed off-campus.

STATUS UNDER SELECTIVE SERVICE—As soon as an applicant has been admitted to the Graduate School, his local board will be informed *provided* the applicant requests it and has given the necessary information. As soon as he receives notification of admission, the applicant should check with the Assistant Registrar to see that everything is in order.

A student is certified to be a full-time student if he schedules at least 12 credits in a semester, if he holds an appointment as a quarter-time or half-time graduate assistant, or if he is serving an internship under approved conditions.

Whenever a student changes his status so as to be no longer considered a full-time student, fails to make satisfactory progress, or makes a drastic change in his declared goal, the local board will be notified.

GRADING SYSTEM—A grade is given to a student solely on the basis of the instructor's judgment as to his scholarly attainment.

For graduate courses (500 series) one of three grades may be given:

H for Honors, indicating definitely superior attainment.

P for Pass, indicating acceptable but not superior attainment.

F for Fail, indicating failure to attain the minimum standards of work acceptable for credit in a degree program.

For research or thesis one of four grades may be given:

H for Honors, indicating definitely superior attainment.

P for Pass, indicating acceptable but not superior attainment.

F for Fail, indicating failure to spend an appreciable amount of time doing the scheduled work or failure to attain the minimum standards of work acceptable for credit in a degree program.

R for Research, indicating that the investigation is continuing and that the student has devoted an adequate amount of time to the work scheduled but that the supervisor does not want to give a quality grade (H, P, or F) at this point. When the project is completed an H, P, or F must be given and will be considered the quality grade for the entire research. Grades of R given while the research was in progress will remain on the student's record permanently.

For 400 series courses one of five grades may be given:

Grade	Percentage Equivalent	Grade Point Equivalent
A	90-100	4
B	80- 89	3
C	70- 79	2
D	60- 69	1
F (Failure)	0- 59	0

Grades below B do not carry graduate credit.

GRADUATION—It is the responsibility of the student to fill out a diploma card during the semester or session when he expects to receive an advanced degree.

Degrees are normally granted at the end of each semester and at the end of the Main Summer Session.

All degrees conferred are tentative until final grade reports have been received even though the student's name may have appeared in the printed commencement program.

Attendance at commencement exercises is an obligation on the part of those receiving advanced degrees. A request to receive the degree *in absentia* may be presented to the Dean of the Graduate School, but only under extraordinary circumstances will it be granted.

FEES AND LIVING ACCOMMODATIONS

REGULAR FEES, PAID EACH SEMESTER:

Students registered for 12 or more credits:

Residents of Pennsylvania	\$134.00
Nonresidents of Pennsylvania, on-campus studies	284.00
Nonresidents of Pennsylvania, off-campus research (610)	134.00

Students registered for fewer than 12 credits:

Residents of Pennsylvania, per credit	12.00
Nonresidents of Pennsylvania, on-campus studies, per credit	25.00
Nonresidents of Pennsylvania, off-campus research (610), per credit	12.00

Vocational education courses:

Total charge for vocational education courses, indicated by "v" following the course number	15.00
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Graduate assistants, fellows, and scholars:

Health and welfare charge	18.00
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SPECIAL FEES, PAID AS OCCASION DEMANDS:

Applicable to all students, including graduate assistants, fellows, and scholars:

Admission to the Graduate School	10.00
Privilege of late registration or late payment	10.00
Change of schedule, each change	2.00
Publication of doctoral thesis abstract	35.00
Binding of thesis, per copy	2.50
Official transcript of record (with seal), each copy	1.00

STUDENT AIDS

The University reserves the right to revise fees without further notice.

With reference to fees, courses that are scheduled for audit are considered the same as though they were scheduled for credit.

Summer sessions students who register for graduate courses pay the regular fees for the summer sessions.

Whenever it shall appear from any of the information presented as part of the application for admission that the applicant is not domiciled in Pennsylvania, the Dean of Admissions, when admission is granted to that applicant, assumes that the one admitted is a nonresident of Pennsylvania and includes that admission as a part of the established out-of-State quota. If the student who is thus admitted believes that his circumstances do not justify his classification as a nonresident of Pennsylvania, he may petition the Dean of Admissions for reclassification.

Whenever a petition for reclassification is made, the petitioner is required to present proof of bona fide continuous domicile of the one admitted (or of his parents, if he is a minor) within the Commonwealth for a period of not less than 12 months immediately preceding the date of such petition for reclassification; and, in addition, such other evidence as may appear pertinent to a complete review of his classification.

Whenever a student changes his domicile during his attendance at the University, such a student is subject to immediate reclassification by the Dean of Admissions.

Any student who does not fulfill payment obligations promptly may be charged \$1 for each day of delinquency up to and including five days, or a maximum of \$10 if the delinquency exceeds five days. A student whose account is delinquent for more than 10 days is subject to suspension from the University.

LIVING ACCOMMODATIONS—A variety of living accommodations are available including rooms in private homes, lodging houses, and to a limited extent in University residence halls. Boarding houses and restaurants are available for meals. The cost varies considerably but has been estimated at approximately \$21 per week, including both board and room. A list of known vacancies is maintained by the offices of the Dean of Men and the Dean of Women and by the Graduate Student Association. The prospective student should write to the appropriate office well in advance of the beginning of school because it may be very difficult to find a convenient location at the last minute.

A married student may find accommodations in apartments, trailers, and rooms in private homes. Personal contact is essential, but assistance may be gained through contact with the office of the Dean of Men or an advertisement in the local newspaper.

A limited number of married students may be admitted to Eastview Terrace, a housing development consisting of small one- and two-bedroom unfurnished units located on the campus. Applications are considered in the order in which they are received. For details write to the Director of Housing, Old Main.

STUDENT AIDS AND SERVICES

ASSISTANTSHIPS—A number of graduate assistantships are available to students who show promise of superior ability to carry on graduate study. An appointee may serve as an assistant in classroom or laboratory instruction, or in research or office work. Exemption from all major fees and charges is granted, but the student must pay the health and welfare charge as well as such specific fees as admission, late

registration, and change of schedule. Privileges for a graduate assistant appointed for the academic year do not extend into any of the summer sessions. A veteran holding an assistantship is not in general eligible for full benefits from the Veterans Administration.

An appointee may not accept additional employment, either at the University or elsewhere, during the period for which service to the University is required under the appointment. Vacation for a graduate assistant consists of the regular student vacations available to graduate students.

A student holding a quarter-time or a half-time assistantship is considered to be following a full-time course of instruction under Selective Service regulations and is certified to his local draft board as a full-time student. A student holding a three-quarter-time assistantship is not considered to be following a full-time course of instruction.

A prospective student should write directly to the head of his major department for information and application forms. Appointments are made upon the recommendation of the department head, subject to admission to the Graduate School and to the approval of the Dean of the Graduate School. Clear evidence of superior ability and promise is required. Reappointment to an assistantship requires a continuing demonstration of good scholarship.

The three types of graduate assistantships vary in stipend, service required, and the number of credits for which the student may register. Not all types will be available in every department.

QUARTER-TIME, requiring about 10 hours of service per week.

For the academic year: stipend \$603-\$801; 11-13 credits per semester.

For the fiscal year: stipend \$804-\$1068; 11-13 credits per semester, 8-9 credits in summer sessions.

HALF-TIME, requiring about 20 hours of service per week.

For the academic year: stipend \$1206-\$1602; 8-10 credits per semester.

For the fiscal year: stipend \$1608-\$2136; 8-10 credits per semester, 6-8 credits in summer sessions.

THREE-QUARTER-TIME, requiring about 30 hours of service per week.

For the academic year: stipend \$1809-\$2403; 6-8 credits per semester.

For the fiscal year: stipend \$2412-\$3204; 6-8 credits per semester, 4-6 credits in summer sessions.

COUNSELORSHIPS—A number of appointments are available to male students to serve as resident counselors in the undergraduate residence halls for men. A counselor's responsibility is to work for the social, academic, and emotional adjustment of the undergraduate residents. Specialized training in personnel work is desirable, though not essential.

These appointments are for the academic year and carry with them remission of fees for room and board, but not exemption from academic fees.

Applications and requests for information should be addressed to the Dean of Men.

FELLOWSHIPS—Approximately 90 fellowships are awarded annually. Recipients must be superior students and are frequently required to have completed a certain minimum of graduate work before being eligible for an award. Fellows carry a full-time graduate program, receive a stipend which varies with the award, and are exempt from all major fees. They may not accept employment during the term of their appointment, nor are they required to render any service to the University.

FELLOWSHIPS

In some cases a fellow will be expected to limit his research to a broad field specified by the donor of the fellowship. Fellows are required to pay the health and welfare charge and other specific fees such as admission, late registration, and change of schedule.

Ten fellowships, each providing a stipend of \$2000 for the academic year, are designated as Graduate School Fellowships. They are available to outstanding advanced graduate students in any field, although preference is given to applicants majoring in the humanities and social sciences. Information and application forms may be secured from the Dean of the Graduate School.

Approximately 80 fellowships, with various stipends, are awarded through the individual departments. Information and application forms may be secured from the head of the major department concerned. The fellowships which are awarded will vary somewhat from year to year, but the following are typical of those which were available for 1956-57:

ALLEGHENY LUDLUM FELLOWSHIP—Open to graduate students in metallurgy for studies in steelmaking.

ALLIED CHEMICAL AND DYE FELLOWSHIP—Open to graduate students in chemical engineering.

ALLIED CHEMICAL AND DYE FELLOWSHIP—Open to graduate students in organic chemistry for the final year of study leading to the Ph.D. degree.

AMERICAN PETROLEUM INSTITUTE FELLOWSHIPS (8)—Open to graduate students in chemistry and physics for research concerning the synthesis and properties of high molecular weight hydrocarbons.

MICHAEL BAKER, JR., FELLOWSHIPS IN PUBLIC ADMINISTRATION—Open to graduate students working for the Master of Public Administration degree.

CAROLINE CAPOZZOLA FELLOWSHIP IN PUBLIC ADMINISTRATION—Open to graduate students working for the Master of Public Administration degree.

CARNEGIE GRADUATE FELLOWSHIPS (3)—Open to advanced level graduate students.

CONTINENTAL OIL COMPANY FELLOWSHIP—Available to graduate students in petroleum and natural gas engineering for studies in petroleum engineering.

CO-OPERATIVE GRANGE LEAGUE FEDERATION FELLOWSHIPS (2)—For research in poultry nutrition and in egg quality, with major interest in biochemistry.

CO-OPERATIVE PROGRAM FELLOWSHIP—Open to graduate students in metallurgy.

CORNING GLASS WORKS FOUNDATION FELLOWSHIP—In support of graduate work on glass or any of its components.

CURTISS-WRIGHT CORPORATION FELLOWSHIP—Open to graduate students in aeronautical engineering, electrical engineering, mechanical engineering, and engineering mechanics.

DANFORTH FOUNDATION FELLOWSHIPS—For graduate students in the natural sciences, social sciences, humanities, and other fields of specialization preparing themselves for college teaching, who see in teaching a vocation of Christian service.

DAVISON CHEMICAL COMPANY FELLOWSHIP—Open to graduate students in mineral preparation engineering.

DOW CORNING FELLOWSHIPS—Open to graduate students in chemistry for fundamental studies in organosilicon compounds.

DU PONT POSTGRADUATE TEACHING FELLOWSHIP IN CHEMISTRY—Open to graduate students in chemistry for the final year of study leading to the Ph.D. degree.

EASTMAN KODAK FELLOWSHIP—Open to graduate students in chemistry for the final year of study leading to the Ph.D. degree.

ELLIOTT FELLOWSHIP IN ENGINEERING RESEARCH—An annuity provided by W. S. Elliott of Pittsburgh for a graduate student in engineering.

FOUNDRY EDUCATIONAL FOUNDATION FELLOWSHIP—Open to graduate students in mechanical engineering, industrial engineering, and metallurgy who have demonstrated interest in foundry technology.

GENERAL ELECTRIC FELLOWSHIP—Open to graduate students in metallurgy.

GULF COMPANY FELLOWSHIP IN PETROLEUM AND NATURAL GAS ENGINEERING—In support of graduate work in petroleum and natural gas engineering for studies in petroleum production.

HALOID FELLOWSHIP IN PHYSICS—In support of graduate work in the field of solid state physics.

HAMILTON STANDARD FELLOWSHIPS (3)—Open to graduates of this University in aeronautical engineering, electrical engineering, and mechanical engineering.

HAZEL-ATLAS GLASS RESEARCH FELLOWSHIP—Available in the Department of Ceramic Technology.

HEYL AND PATTERSON FELLOWSHIP—Open to graduate students in mineral preparation engineering.

HUMAN FACTORS RESEARCH PROGRAM FELLOWSHIP—Open to graduate students in the Department of Psychology for the final year of study leading to the Ph.D. degree.

JONES AND LAUGHLIN STEEL CORPORATION FELLOWSHIP in refractories.

KENNECOTT COPPER CORPORATION FELLOWSHIP IN GEOPHYSICS—Open to graduate students in geophysics for studies relating to mining geophysics.

LITHIUM CORPORATION OF AMERICA FELLOWSHIP—Open to graduate students in ceramic technology for studies in inorganic lithium compounds and lithium oxide systems.

NATIONAL CARBON DIVISION OF UNION CARBIDE AND CARBON CORPORATION FELLOWSHIP—In support of graduate work on carbon and related materials or in the field of solid state physics.

NEW YORK LIFE INSURANCE COMPANY FELLOWSHIP—Open to graduate students in insurance.

EDWARD ORTON, JR., CERAMIC FOUNDATION FELLOWSHIP—Open to graduate students in ceramics for studies relating to kiln-fired ceramic bodies.

PENNSYLVANIA BANKERS ASSOCIATION FELLOWSHIP—Open to graduate students in money and banking.

PENNSYLVANIA CO-OPERATIVE WILDLIFE RESEARCH FELLOWSHIPS (3)—Funds supplied by the Pennsylvania Game Commission for investigations dealing with wildlife management.

PITTSBURGH CONSOLIDATION COAL COMPANY FELLOWSHIP—Open to graduate students in fuel technology for research leading to the Ph.D. degree.

ROCHESTER AND PITTSBURGH COAL FELLOWSHIP—Open to graduate students in mining engineering.

SHELL COMPANY FELLOWSHIP IN CHEMICAL ENGINEERING—In support of graduate work in chemical engineering, preferably for students in their last year of doctoral work.

SHELL COMPANY FELLOWSHIP IN CHEMISTRY—Open to graduate students in the Department of Chemistry for the final year of study leading to the Ph.D. degree.

SPEER CARBON FELLOWSHIP—Open to graduate students in fuel technology for studies on carbon.

FELLOWSHIPS

SPERRY GYROSCOPE COMPANY FELLOWSHIP—Open to graduate students in electrical engineering.

SPRAGUE ELECTRIC COMPANY FELLOWSHIP—Open to graduate students in ceramic technology for studies in the field of ceramic dielectrics.

STACKPOLE FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy for studies in powder metallurgy.

STACKPOLE CARBON FELLOWSHIP—Open to graduate students in ceramic technology for studies in the field of ceramic ferrite materials.

STACKPOLE CARBON FELLOWSHIP—Open to graduate students in fuel technology for studies on carbon.

STANOLIND FELLOWSHIP IN PETROLEUM AND NATURAL GAS ENGINEERING—Available to graduate students in petroleum and natural gas engineering for studies in petroleum production.

STEARNS MAGNETIC, INC., FELLOWSHIP—Open to graduate students in mineral preparation engineering.

L. L. STEARNS AND SONS FELLOWSHIP—Open to graduate students in retailing.

ST. JOSEPH LEAD COMPANY FELLOWSHIP—Open to graduate students in metallurgy for studies in chemical metallurgy.

SYLVANIA FOUNDATION FELLOWSHIP—Open to graduate students who wish to do research in metallurgy, ceramics, or solid materials related to the electronics industry.

TITAN METAL FELLOWSHIP IN METALLURGY—Open to graduate students in metallurgy for studies on copper-base alloys.

UNION CARBIDE AND CARBON FELLOWSHIP—Open to graduate students in chemistry for the final year of study leading to the Ph.D. degree.

UNION CARBIDE AND CARBON FELLOWSHIP—Open to graduate students in the College of Mineral Industries.

UNITED STATES STEEL FOUNDATION FELLOWSHIP—Open to graduate students in the College of Mineral Industries for studies related to steel-making.

YOUNGSTOWN SHEET AND TUBE COMPANY FELLOWSHIP—Open to graduate students in mining engineering.

JOHN W. WHITE FELLOWSHIPS—Awarded to two graduates of The Pennsylvania State University each year on the basis of scholarship, need, character, and attitude. The recipients may enroll in any approved college or university.

In addition, numerous grants are available from governmental agencies, industrial concerns, and foundations for the support of investigations of particular problems. Many of these permit full-time study and carry the same fee exemptions as the fellowships listed above. Detailed information may be secured from departments.

LOAN FUNDS—Funds are available for limited loans. Applications should be addressed to the Dean of Men or the Dean of Women.

SCHOLARSHIPS—A number of scholarships are awarded annually. Applications should be addressed to the Dean of the Graduate School and must be received by March 1 in order to be considered for the following academic year.

GRADUATE SCHOLARSHIPS—Forty are awarded each year. These scholarships carry no stipend but do grant exemption from all major fees. Recipients are required to take a full program of graduate work and may be required to render some service.

A.A.U.W. SCHOLARSHIP—The State College Branch of the American Association of University Women has established a scholarship for a woman graduate student. The amount of the award varies and does not include fee exemption.

STUDENT EMPLOYMENT—Many students depend partly on their own earnings to help meet their expenses. The Student Employment Office, 112 Old Main, gives information on part-time jobs. A student not holding an assistantship, fellowship, or scholarship who wants a part-time job should register with the Student Employment Office as soon as his class schedule has been arranged. While some students find regular part-time work, many of them depend on a series of odd jobs, some of which are of a continuing nature.

VETERANS BENEFITS—The Co-ordinator of Veterans Affairs is charged with the responsibility of handling all applications for benefits under the various Public Laws.

Under P.L. 550 the responsibility for classifying students as to their rate of training rests with the Dean of the Graduate School. The classification is based on the extent to which the student devotes himself to his graduate program (as contrasted with the service for which he receives remuneration) and is not directly determined by the number of credits scheduled. Thus a student who is employed about 20 hours per week and devotes the remainder of his time to graduate work would be considered a half-time student on the basis of his employment regardless of how many credits he was permitted to schedule. In the case of graduate assistants, however, a quarter-time assistant is considered to be a full-time student, a half-time assistant a three-quarter-time student, and a three-quarter-time assistant a half-time student, insofar as benefits under P.L. 550 are concerned.

HEALTH CENTER—Health service is available to any graduate student who registers for 12 or more credits or who holds an appointment as a graduate assistant. This service endeavors to conserve, maintain, and promote the health of students. Consult the *Manual for Graduate Students* for details concerning its facilities and services.

PLACEMENT SERVICE—The University Placement Service is designed to coordinate the placement activities of all the Colleges and the Graduate School. The services of the following divisions are available to the student without charge.

The Placement Service functions primarily as a clearing house, bringing together students, alumni, faculty members, and representatives of organizations that are seeking college-trained personnel. Summer jobs other than those at camps or resorts are listed at this office.

The Teacher Placement Division is maintained to assist seniors, alumni, and graduate students in all departments in securing teaching positions for which they are qualified.

The Student Employment Division offers assistance to students in finding part-time employment in town and on the campus, as well as summer employment at camps and resorts. A student must be registered to be informed of jobs.

The divisions of the University Placement Service are available to any student, regardless of level, who is in need of counseling or guidance on employment problems.

RELIGIOUS PROGRAMS—The University seeks to serve the spiritual needs of its students and staff. General responsibility for religious activity on the campus rests with the University Chaplain and Co-ordinator of Religious Affairs. Individual organizations under the sponsorship of members of the Jewish, Protestant, and Roman Catholic faiths serve the student body. Many other religious organizations, including denominational and interdenominational groups, are active on the campus and in association with local churches.

ACADEMIC DEGREES

STUDENT AFFAIRS—The Graduate Student Association is the official University-wide organization of graduate students. All students enrolled during the academic year have membership in the Association. Its particular function, according to its constitution, is "to give the individual member occasion for relaxation through its social program, intellectual stimulation of interests, and the opportunity to express and ameliorate problems through discussion and collective action."

SUMMER SESSIONS—A series of sessions covering a total period of 12 weeks are arranged each summer. During this time there are excellent opportunities for graduate work in many fields. Detailed information can be secured from the *Summer Sessions Complete Announcement*, which is published about April 1 and may be obtained by writing to the Director of Summer Sessions.

It is the aim of the University to make available its staff and resources during the summer to aid students to the fullest possible extent in their programs of graduate study and research. The University cannot guarantee, however, that all the services normally offered during the academic year will be at hand during the summer.

To avoid disappointments, a student who plans to present a thesis for final consideration or to take the final doctoral examination during the summer sessions should inform the chairman of his committee and the head of his department of his intentions prior to June 1. A notice of approval will be sent to the student if the necessary staff members will be available to provide the service requested.

A graduate student desiring to carry forward a special graduate program or research project not officially listed as a part of the summer sessions should, likewise, obtain written approval of his plans from the chairman of his committee and the head of his department prior to June 1.

ACADEMIC DEGREES

MASTER OF ARTS AND MASTER OF SCIENCE

These two degrees have similar requirements and the particular degree conferred upon the student is determined by the general area of his major field.

ADMISSION—Adequate undergraduate preparation is required in the field in which the applicant expects to pursue advanced work. The specific courses and the total number of undergraduate credits required in various areas will be determined by the choice of field and can be ascertained from the Dean of Admissions. An applicant who meets the minimum grade point average but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A program for the master's degree requires a minimum of 30 credits and consists of a major and either a minor or a group of general studies. A minor consists of no fewer than 6 credits of integrated or articulated work in one field related to but different from that of the major. A general studies group consists of no fewer than 6 credits in fields other than that designated as the major field considered by the major department to have significance and value for the candidate.

The program requires the equivalent of at least one academic year (two semesters), and may be met by full-time residence, part-time work, attendance in the summer

DOCTOR OF PHILOSOPHY

sessions, or by any combination of these. Many students find that adequate programs leading to the master's degree involve considerably more than 30 credits and require more than one year's work. Ten credits earned in residence at another approved institution or in the extension classes of The Pennsylvania State University may, under certain conditions, be offered in partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A minimum of 12 credits in course work, as contrasted with research, must be completed in the major field and at least 6 credits in addition must be devoted to a thesis. At least 18 credits in graduate courses (500 series) and thesis research combined must be offered toward the fulfillment of minimum requirements for the degree. A student's program must be approved by his adviser and the Dean of the Graduate School.

In addition to the above general requirements, a major department may set up specific course and subject-matter requirements for students working in its area.

The mere completion of a stated amount of work does not entitle a student to recommendation for a degree. He must pass examinations upon such subjects and at such times as shall be designated by the departments concerned and must present an acceptable thesis.

THESIS—Under the direction of the department in which the student's major subject is taken, he must prepare a thesis upon a suitable topic related to that subject. Under certain conditions a student may be permitted to complete the thesis *in absentia*. To obtain such permission he must make satisfactory arrangements in advance with both the major department and the Dean.

A copy of detailed regulations concerning format, paper, illustrations, etc. may be obtained at the Graduate School office.

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is conferred in recognition of high attainments and productive scholarship in some special field of learning as evidenced by (1) the satisfactory completion of a prescribed period of study and investigation, (2) the preparation of a thesis involving independent research, and (3) successfully passing examinations covering both the special subject and the general field of learning of which this subject forms a part.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State University in regular semesters. During at least two semesters, if he be a part-time student, the candidate is expected to limit his work load to half-time at most and to devote the balance of his time to his graduate program. A minimum of three academic years of full-time graduate study and research, or their equivalent in credits, is required for the attainment of a doctor's degree. The equivalent of two academic years may be secured by residence at another approved institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and thesis requirements within the period of one academic year on this campus.

Subject to the approval of his adviser, the head of his major department, and the Dean of the Graduate School, a student may register for research to be done off-campus. Such work will not be approved, however, simply because the arrangement is convenient for the student; scholarly considerations must determine the choice of location.

DOCTOR OF PHILOSOPHY

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The program shall consist of such a combination of courses and research as is approved by the doctoral committee for each individual student, and includes a major and either a minor or a general studies group. Approximately two-thirds of the total time is to be devoted to the major field. A minor consists of no fewer than 15 credits, including those applied toward the master's degree, of integrated or articulated work in one field related to but different from that of the major. A general studies group consists of no fewer than 15 credits, including those applied toward the master's degree, in fields other than that designated as the major field and considered by the major department to have significance and value for the candidate.

The first year of graduate study leading to the doctor's degree may be substantially the same as that provided for the master's degree and may lead to that degree, although that is not necessary.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Philosophy must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of graduate work (including work done for the master's degree and work done elsewhere as well as here; i.e., at about the time he has earned a total of 30 graduate credits). A new student transferring from another graduate school with 30 or more transfer credits must take this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department. If the student passes the examination, and in the opinion of the graduate faculty of his major department is qualified to follow a doctoral program, he is admitted to candidacy.

After a student has been admitted to candidacy the Dean upon recommendation of the head of the major department will appoint a doctoral committee which will thereafter guide him in candidacy.

For the Doctor of Philosophy degree, candidates are required to have a reading knowledge of at least two foreign languages. German and French are the languages most often needed. Other languages may be presented instead of these if their choice is determined by scholarly and professional reasons. The choice of a language must be approved by the major department. If a language other than English, French, German, Italian, Spanish, or Russian is presented, it must be approved also by the Dean of the Graduate School. A student may not present his mother tongue as one of the two languages required in candidacy. Candidates may present certification of having passed equivalent language examinations in other institutions in lieu of repeating the examinations. For further details, see the *Manual for Graduate Students*.

When a doctoral candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether he has adequate mastery of the subject matter to entitle him to proceed to the completion of a thesis. The candidate must have satisfied the language requirements before taking this examination.

A doctoral candidate who has satisfied all other requirements for the degree will be scheduled, on recommendation of the doctoral committee, to take a final examination. In no case may the final examination be scheduled less than three months after the comprehensive examination. The final examination is oral, open to the

public, related in large part to the thesis, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

THESIS—The ability to do independent research and competence in scholarly exposition must be demonstrated by the preparation of a thesis on some topic related to the major subject. It should represent a significant contribution to knowledge, be presented in a scholarly manner, reveal on the part of the candidate an ability to do independent research of high quality, and indicate considerable experience in using a variety of research techniques. The contents and conclusions of the thesis must be defended at the time of the final examination.

The completed thesis together with an abstract, typewritten in triplicate, must be filed in the office of the Dean of the Graduate School not later than two weeks prior to the commencement at which the candidate expects to receive the degree.

A copy of detailed regulations concerning format, paper, illustrations, etc. may be obtained at the Graduate School office.

PROFESSIONAL DEGREES

MASTER OF EDUCATION

The degree of Master of Education represents general scholarship, acquaintance with the chief phases of educational literature, teaching skill, qualities of leadership in educational work, and ability to solve concrete problems in at least one special field of educational activity.

ADMISSION—An applicant is required to have had at least 27 undergraduate credits in the field of education, including practice teaching, except that under certain circumstances this rule may be waived for a student working for the Doctor of Education degree with a major in higher education. An applicant choosing a major outside the fields of education (such as mathematics, geography, or history) will be expected to have in addition an adequate undergraduate preparation in the field of specialization. The specific course requirements and the total number of undergraduate credits required in the various areas will be determined by the choice of field. An applicant who meets the minimum grade point average for admission but is deficient in course preparation may, under certain circumstances, be admitted to the Graduate School and allowed to make up the undergraduate deficiencies. Under these circumstances the program will require more than the minimum period of residence.

REQUIREMENTS—A minimum of 30 credits is required, of which 6 may be granted for an approved thesis. The program requires the equivalent of one academic year (two semesters) and may be met by full-time residence, part-time work, attendance in the summer sessions, or any combination of these. Ten credits earned in residence at another approved institution or in extension classes of The Pennsylvania State University may, under certain conditions, be offered as partial fulfillment of the requirements. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A minimum of 24 credits must be earned in graduate course work. The larger part of this work shall be in courses open only to graduate students, but the needs of the student shall be considered in arranging the best combination of courses (400

DOCTOR OF EDUCATION

and 500 series) for the preparation of the candidate in his special field. The degree program must be approved by the student's adviser or advisory committee.

When the student chooses a group major, his study program will be approved by a standing committee (or its representatives), which committee will foster the student's interests and stand in the same relation to him as does a department in the case of a student with a specific major. Such standing committees have been appointed in the broad fields of biological science, physical science, and social studies.

Those candidates who do not elect to write a thesis are required to present an essay or term paper. It must be of considerable proportion, giving evidence of their capacity to describe a serious intellectual experience in writing, and giving unmistakable evidence of ability to formulate and state meaningfully the purpose of an investigation, study, critical analysis or evaluation, to acquire and analyze information, to draw conclusions logically, and to relate findings to professional problems and practices. The particular nature and extent of such a piece of writing (whether it be required in connection with a course or independently of course work), and when it is to be undertaken, shall be determined by the major department.

MAJOR AND MINOR FIELDS—If a student looks forward to a career as a teacher, he may choose a major outside the fields of education (such as English, mathematics, or geography) and take the majority of his work in that field. In this case the student is required to have a minor consisting of no fewer than 6 credits in basic education (includes specific courses in comparative education, educational measurements and statistics, educational psychology, history of education, and philosophy of education). If he can demonstrate by examination an adequate background in basic education, he may choose a minor in any field of education.

If a student wishes to work in a broader field, a group major such as social studies, physical science, or biological science may be chosen. In this case at least 24 credits are to be devoted to the group, and no fewer than 6 credits to a minor in basic education. It is expected that each student will choose one subject of the group as a field of primary interest, to which at least 12 credits are to be devoted.

If a student looks forward to a career as an administrator, a guidance counselor, or a supervisor, he may specialize in one of the fields of education and choose that as his major. In this case the student is required to have a minor consisting of no fewer than 6 credits in either a field outside of education or in basic education as defined above.

A candidate majoring in education is required to take a departmental qualifying examination, comprehensive in scope, before completing the second half of his course requirements. This serves as a guide in outlining a program of study that will fit his individual needs.

DOCTOR OF EDUCATION

The degree of Doctor of Education is conferred in recognition of scholarship and teaching or administrative skill as evidenced (1) by the satisfactory completion of a prescribed period of study; (2) by the application of scientific principles in classroom teaching, in the supervision of instruction, or in administrative work; (3) by the preparation of a thesis demonstrating ability to undertake an educational problem with originality and independent thought; (4) by successfully passing examinations showing a satisfactory grasp of the field of specialization and its relation to allied subjects; and (5) by recognized leadership in the profession of education.

RESIDENCE REQUIREMENTS—A candidate must earn at least 30 credits in residence at The Pennsylvania State University. This requirement may be met by attendance at summer sessions, although there is no guarantee that it will be possible to do so in all cases. A minimum of three academic years of full-time graduate study and research, or their equivalent in credits, is required for the doctor's degree. However, it is not required that the three years be continuous. Graduate study may be carried on through a longer period and paralleled by teaching or administrative work.

The equivalent of two full years of work may be secured by residence at another approved institution, or by a combination of one year at another institution and one year of off-campus research. Even though two years of advanced standing be granted, it is usually impossible to meet course, examination, and thesis requirements within the period of one academic year on this campus. Credit for courses and research work done elsewhere can be used to meet degree requirements only if appropriate to the candidate's proposed program of study as determined by his doctoral committee.

A doctoral candidate may register for a maximum of 30 credits of off-campus research to be done in the public schools or in other approved centers. The arrangement must be approved by the adviser, the head of the major department, and the Dean of the Graduate School in advance of registration. The maximum load permitted for a student who is fully employed is 6 credits in a semester and 5 credits in the summer.

PROGRAM—There is no specified number of courses or credits the earning of which will guarantee the attainment of the doctor's degree. The general requirements are based not upon courses or credits but upon a period of residence, a satisfactory thesis, the passing of comprehensive examinations, and possession of the qualities of professional leadership. A program shall consist of such a combination of courses and individual study and research as is approved by the doctoral committee for each candidate. The program of study shall be so arranged as to lead toward high professional mastery within some area of educational service. A majority of the courses offered in fulfillment of the requirement must be in the major field of study.

A candidate choosing a major outside the fields of education (such as chemistry, English, or history) shall have a minor consisting of no fewer than 15 credits, including those applied toward the master's degree, in psychology and basic education (includes specific courses in comparative education, educational measurements and statistics, educational psychology, history of education, and philosophy of education).

A candidate choosing a major in one of the fields of education must also choose either a minor or a general studies group with the approval of the major department. In this case a minor consists of no fewer than 15 credits, including those applied toward the master's degree, in one field outside the fields of education. An acceptable general studies group consists of no fewer than 15 credits, including those applied toward the master's degree, in fields outside the fields of education considered by the major department to have significance and value for the candidate. Every candidate must show through comprehensive examinations that he is familiar with current theories of education, that he understands and can apply the techniques and the findings of educational research so far as they bear upon the teaching of his subject, that he is prepared to read understandingly and contribute to the technical and professional literature in his field, and that he can criticize his own procedures in the light of historical trends and practices in this and other countries. Command of the tools for a thorough study of the problems of education is neces-

DOCTOR OF EDUCATION

sary and must include familiarity with statistical methods. For certain students the requirements may include a reading knowledge of one or more foreign languages.

After one year of acceptable graduate work, either here or elsewhere, a student may be admitted to candidacy for the doctor's degree, provided that he has satisfied the major department (in the manner indicated below) that he is prepared to proceed.

CANDIDACY AND EXAMINATIONS—A student expecting to become a candidate for the degree of Doctor of Education must present himself for a doctoral candidacy examination near the end of the first, or at the beginning of the second, year of graduate work (including work done for the master's degree and work done elsewhere as well as here; i.e., at about the time he has earned a total of 30 graduate credits). A new student transferring from another graduate school with 30 or more transfer credits must take this examination before he has earned more than 10 credits here. Arrangements for the examination are made by the major department.

Three of the important factors taken into consideration in passing judgment upon admission to candidacy are:

1. Previous scholastic record at this institution and other institutions attended.
2. Achievement in candidacy examinations.
3. Estimates of the student's personal and professional qualifications by the graduate faculty of the major department.

After a student has been admitted to candidacy, the Dean, upon recommendation of the head of the major department, will appoint a doctoral committee which will thereafter guide him in candidacy.

When the candidate has substantially completed his course work, he will be given a comprehensive examination covering his major and minor fields to determine whether or not he may proceed to the completion of his thesis. This examination will be designed to test (1) the candidate's general scholastic preparation and professional background, and (2) his ability to integrate and apply his knowledge in his fields of specialization to practical situations so as to reflect an intelligent mastery of the subjects.

A candidate who has fulfilled all other requirements for the degree will be scheduled, on recommendation of his doctoral committee, to take the final oral examination for the degree. The committee in charge of this examination will consist of the student's doctoral committee and others appointed by the Dean of the Graduate School. In no case may the final examination be scheduled less than three months after the comprehensive examination. The final examination will be based largely upon the thesis, but may cover the whole field of study of the candidate without regard to courses that have been taken either here or elsewhere.

THESIS—Evidence of a high degree of scholarship, competence in scholarly exposition, and ability to select, organize, and apply knowledge must be presented by the candidate in the form of a written thesis. The candidate must demonstrate capacity for independent thought as well as ability and originality in the application of educational principles or in the development of new generalizations under scientific controls. The topic and outline of the proposed thesis must have the approval of the doctoral committee.

The completed thesis together with an abstract, typewritten in triplicate, must be filed in the office of the Dean of the Graduate School not later than two weeks prior to the commencement at which the candidate expects to receive the degree.

A copy of detailed regulations concerning format, paper, illustrations, etc. may be obtained at the Graduate School office.

MASTER OF FORESTRY

The degree of Master of Forestry represents scholastic ability, acquaintance with forestry literature, and technical knowledge of one or more of the several specialized fields in forestry or wood utilization. It is offered to provide an opportunity for additional study in a student's particular field of interest rather than for research work on a special problem, though such work is not precluded under the requirements for the degree.

ADMISSION—An applicant for admission is required to hold a baccalaureate degree, or its equivalent, from a recognized professional school of forestry. Full information concerning the preparation required in either general forestry or wood utilization is on file in the office of the Dean of Admissions. If there are deficiencies at the time of admission, they must be removed early in the program. While making up deficiencies in prerequisite credits, the student must follow a program approved by his advisory committee. Deficiencies in grade point average will lead to refusal of admission to the Graduate School.

REQUIREMENTS—A minimum of 30 credits is required for the degree of Master of Forestry. It is expected that the larger part of the program shall be in graduate courses, but no specific number of credits in the 500 series is required. A thesis representing a minimum of 6 credits must be prepared. Under certain conditions a student may be permitted to complete the thesis *in absentia*. To obtain such permission he must make satisfactory arrangements in advance both with the head of the department and with the Dean. All requirements, whether satisfied here or elsewhere, must be met within six years, or a period spanning seven consecutive summers.

A maximum of 10 credits earned in extension classes of The Pennsylvania State University or in resident classes of other approved institutions may, under certain conditions, be applied toward the degree provided they fit into the program of the student.

A student should choose one field of work for his major interest, with one or two related minor fields. The proportion of credits to be taken in the major and minor fields of study will be determined in consultation with the student's advisory committee.

MASTER OF PUBLIC ADMINISTRATION

The program leading to the degree of Master of Public Administration is designed to provide pre-service training for students planning to enter the field of public administration at the national, state, or local level. It is a terminal program and cannot be applied toward a doctorate.

ADMISSION—An applicant must be admitted to the Graduate School and be approved by a departmental committee before entering upon the program. A class of limited size will be selected on the basis of scholastic records, occupational interest, and general qualifications. An all-University average of at least B is required. Selection will be largely from majors in liberal arts, business administration, and engineering.

REQUIREMENTS—The program covers a 12-month period and consists of two semesters of work on campus, followed by an internship of 6 weeks in some governmental agency. The course of study is made up of subject blocks, such as organi-

TECHNICAL DEGREES

zation, management, personnel administration, budgeting, finance, accounting, public works administration, administrative law, planning, statistics, report writing, speech, and public relations. The student has a major in public administration and a minor in either public finance or public works depending upon his interest.

In lieu of a thesis, the student is required to submit an extensive written report on a project which has been carried out during his internship.

The Institute of Local Government serves as the agent of the Department of Political Science for the purpose of administering the program.

TECHNICAL DEGREES

The degrees conferred are Fuels Engineer, Ceramic Engineer, Engineer of Mines, Metallurgical Engineer, and Petroleum Engineer.

ADMISSION—A graduate of the College of Mineral Industries of The Pennsylvania State University may be admitted to work for a technical degree, provided he submits evidence of having been engaged for a period of not less than three years in acceptable professional work in the field in which the application for the degree is made.

A technical degree may also be granted to an engineer of approved practical experience who is a graduate in engineering of another institution of equal standing, on completion of at least three years of full-time teaching or research work in engineering in a professorial rank in this institution, and upon presentation of an acceptable thesis and the fulfillment of all other requirements for technical degrees.

An applicant for a technical degree must file with the Dean of Admissions an application filled out in duplicate on the prescribed forms, approved by the head of the department in which the undergraduate work was completed. The application should be accompanied by the admission fee of \$10.

REQUIREMENTS—Not less than three years shall have elapsed from the time of receiving the first degree before a graduate of this institution shall be permitted to file his application for a technical degree. The application for a technical degree shall include evidence of a satisfactory professional record, which must be approved by the executive committee of the undergraduate College concerned.

Registration for these degrees is the same as for resident students. A candidate must be registered during two regular semesters.

In order to be recommended for a technical degree, the candidate must prepare a thesis on a subject related to his profession, and he may be required to appear in person to defend his thesis.

THESIS—Immediately following registration the candidate must submit for approval an outline of his proposed thesis; and at least six weeks prior to the day on which the degree is to be conferred, the complete thesis must be in the office of the head of the department concerned.

PROGRAMS
and
COURSES

PROGRAMS AND COURSES

PROGRAMS of study leading to advanced degrees are offered in many major and minor fields. These are listed in alphabetical order in the following section, and the major fields are summarized on page 47. Related courses are grouped together under the name of the field. To locate a particular field or group of courses consult the index.

In general, departments of the University are identified with specific major fields of study. Thus aeronautical engineering is a major field which is offered under the supervision of the Department of Aeronautical Engineering. On the other hand, biological science and comparative literature are major fields for which there are no corresponding departments. In such cases a committee of the Graduate School is responsible for administering the program. In some cases a single department offers work in more than one field. Thus the Department of Civil Engineering offers work in both civil and sanitary engineering.

Applicants for admission are encouraged to consult the person whose name is listed under the major field heading.

DEGREES—In those major fields approved for the doctorate the Ph.D. is normally conferred, although a program leading to the D.Ed. may also be arranged with the consent of the department or committee in charge if such a professional program is appropriate. Similarly in major fields approved for the master's degree the M.A. or M.S. is normally conferred, but a program leading to the M.Ed. may also be available. The D.Ed. and M.Ed. are not limited to the fields of education, but with the consent of the department or committee in charge may be offered in any approved major field appropriate to the preparation of teachers, such as chemistry, English, etc. In this case the program is sponsored by a major department outside the fields of education, such as the Department of Chemistry, but the student's minor is in education.

MINOR FIELDS—All major fields listed are also acceptable as minors. In addition, a few fields in which no advanced degrees are offered have been approved as minors for candidates who are majoring in related areas. Such minor fields are identified by a brief statement under the field heading.

A candidate's choice of minor field depends upon the particular degree he is seeking and is subject to the approval of his major department. The requirements in each minor field are established by the minor department subject to the regulations of the Graduate Faculty.

OTHER FIELDS—Fields which have not been approved for either major or minor work at this institution, but in which approved courses are offered, are listed in Part II of this section. These courses may be used in graduate programs as electives or as part of a general studies program, subject to the approval of the major department and to the restrictions upon the use of 400 series courses in degree programs.

COURSE NUMBERING SYSTEM—Courses in the series 1-399 are not listed in this bulletin because they are strictly undergraduate courses and yield no graduate credit. A graduate student may register for or audit these courses in order to make up deficiencies or fill in gaps in his earlier education but not to meet requirements for an advanced degree.

Courses in the series 400-499 are for upperclassmen with at least junior standing and for graduate students. Only a limited number of credits earned in these courses

PROGRAMS AND COURSES

may be counted toward the requirements for an advanced degree. Detailed regulations are given in the preceding section of this bulletin.

Courses in the series 500-599 are restricted to students registered in the Graduate School and other students who, in exceptional cases, have been granted permission to enroll by the Dean of the Graduate School.

Course numbers 600 and 610 apply to research and thesis and are available only to students registered in the Graduate School.

COURSE DESCRIPTIONS—A course abbreviation, a number, and a title designate each course. Course designations and official abbreviations are listed at the left-hand margin just above the first course in each group. The figures in parentheses following the course title show the number of credits which may be granted for that course. In the case of courses with variable credits, the number of credits which may be earned in a single semester or session is determined by the department offering the course.

A department may schedule an entire section of a course below the 400 level for fewer credits than the maximum authorized. In 400 and 500 series courses a department may schedule an individual student for fewer credits than the maximum number but in no case for more than the maximum number authorized.

The letter "X" following a course number indicates that the course is approved for extension classes. The letter "S" following a course number indicates that the course is approved only for summer sessions and not for the academic year. The letter "v" following a course number indicates a vocational education course.

In many cases the name of the instructor who usually teaches the course is listed after the course description.

SCHEDULE OF COURSES—Not all courses are given each semester or session. A complete list of the courses which will be offered in any specific semester is given in the *Timetable*, which is available at nominal cost from the Registrar's Office a few weeks before the beginning of each semester. The *Timetable* gives the number of credits being offered in each course, the hours at which the class will meet, the location of the class, and in some cases the instructor's name.

The courses being offered during a specific summer session are given in the *Complete Announcement of the Summer Sessions* for that year. This announcement, which includes a timetable for summer sessions classes, may be obtained from the Summer Sessions office a few weeks before the beginning of the first session.

The list of courses given in the *Timetable* and the *Complete Announcement of the Summer Sessions* is subject to modification at registration time. The number enrolling in a course, the availability of staff members, and other circumstances may result in the cancellation of some courses and the offering of others. Decisions are made by the departments offering the courses.

RESEARCH AND THESIS WORK—In general, students registering for research or for work on a master's or a doctor's thesis will, if it is to be done in residence, use course number 600 preceded by the appropriate course abbreviation. Thus Aro.E. 600 signifies research or thesis in aeronautical engineering. In case such work has been authorized as off-campus work for nonresident students, the number 610 will be used. Credits will be 1 to 15 per semester.

It should be assumed that the numbers 600 and 610 are available during the academic year in all fields in which majors have been approved for advanced degrees although these numbers do not appear in the timetables. In the summer, however, research and thesis work is usually available only in those fields for which 600 and 610 numbers appear in the *Complete Announcement* and the *Summer Sessions Timetable* for that year.

FIELDS IN WHICH BOTH MASTERS' AND DOCTORS' DEGREES ARE OFFERED

Aeronautical Engineering	German
Agricultural and Biological Chemistry	Guidance
Agricultural Economics	*Higher Education
Agricultural Education	History
Agronomy	Home Economics Education
Animal Husbandry	Home Management and Family
Animal Nutrition	Economics
Art Education	Horticulture
Bacteriology	Industrial Arts Education
Botany	Mathematics
Business Administration	Mechanical Engineering
Business Education	Metallurgy
Ceramic Technology	Meteorology
Chemical Engineering	Mineral Economics
Chemistry	Mineral Preparation
Child Development	Mineralogy
Civil Engineering	Mining
Clinical Speech	Music Education
Clothing and Textiles	Nutrition
Comparative Literature	Petroleum and Natural Gas Engineering
Dairy Science	Physical Education
Economics	Physics
Educational Administration	Plant Pathology
Electrical Engineering	Political Science
Elementary Education	Poultry Husbandry
Engineering Mechanics	Psychology
English	Recreation Education
Family Relationships	Romance Languages and Literatures
Fuel Technology	Rural Sociology
General Home Economics	Secondary Education
Geochemistry	Sociology
Geography	Speech
Geology	Vocational Industrial Education
Geophysics	

FIELDS IN WHICH ONLY A MASTER'S DEGREE IS OFFERED

Agricultural Engineering	Journalism
Architectural Engineering	Music
Architecture	Nutrition in Public Health
Art	Philosophy
Biological Science	Physical Science
Child Development and Family	Public Administration
Relationships	Sanitary Engineering
Entomology	Social Studies
Foods	Theatre Arts
Forestry	Wildlife Management
Industrial Engineering	Zoology
Institution Administration	

* The doctor's degree is conferred in this field but not the master's degree.

Part I

Courses in Major and Minor Fields

AERONAUTICAL ENGINEERING

HAROLD M. HIPSH, *Head of the Department*
203 Engineering D

The department offers graduate programs leading to the M.S. and Ph.D. degrees. Course work and research are available in aerodynamics, structures, aeroelasticity, turbomachinery, and dynamics.

A student should have a B.S. degree in engineering, mathematics, or physics to be admitted to graduate work in aeronautical engineering. He must have satisfactorily completed undergraduate courses in statics, dynamics, strength of materials, and mathematics at least through ordinary differential equations but preferably through vector analysis.

AERONAUTICAL ENGINEERING (ARO E)

401a,b,c. AERONAUTICAL ENGINEERING PROJECTS (2-12)

402. DESIGN AND TESTING OF AIRCRAFT ENGINE COMPONENTS (3)

403. APPLIED AERODYNAMICS (3)

404. AIRPLANE DESIGN AND TESTING (3)

407. ROTARY WING AIRCRAFT (3)

408. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3)

409. AIRCRAFT STRUCTURAL DETAIL DESIGN (3)

410. AIRCRAFT PROPULSION (3)

411. AEROELASTICITY (3)

412. THEORETICAL AERODYNAMICS (3)

413. GUIDED MISSILES (3)

414. AIRCRAFT PRELIMINARY DESIGN (3)

415. ADVANCED THEORETICAL AERODYNAMICS (3)

416. MISSILE SYSTEMS LECTURES (0)

417. MISSILE SYSTEMS LECTURES (0)

501. AIRPLANE STABILITY AND CONTROL (3) General analysis of longitudinal and lateral stability of airplanes; characteristics of flight control devices. Prerequisite: Aro.E. 403.

503. AIRPLANE PERFORMANCE (3) Methods of performance prediction and performance flight testing for high-speed aircraft and missiles. Prerequisite: Aro.E. 403.

504. ROTARY WING AIRCRAFT (3) Types of rotary wing aircraft; helicopter performance, stability, and control; structural and vibration problems. Prerequisites: Aro.E. 403, 409.

505. AIRCRAFT VIBRATION AND FLUTTER (3) Vibrating systems with several degrees of freedom; analysis of flutter speed of an airplane wing considering bending, torsion, and aileron motions; other types of aircraft flutter. Prerequisites: Aro.E. 1, M.E. 54.

AERONAUTICAL ENGINEERING

506. AIRCRAFT STRUCTURES (3-9) Deflections of beams and trusses; statically indeterminate structures; shear-flow analysis and shearing deformations of multicell semi-monocoque structures; effects of discontinuities in wing and fuselage structures. Prerequisites: Aro.E. 409; Aro.E. 411 or E.Mch. 408.
507. AIRCRAFT GAS TURBINES AND JET PROPULSION ENGINES (3) Types of jet propulsion installations, thermodynamic cycles, analysis of compressors, combustion chambers, and turbines. Prerequisite: Aro.E. 410.
510. AERODYNAMICS OF COMPRESSIBLE FLUIDS (3) One-dimensional motion, shock waves, flow in nozzles, two-dimensional flow, airfoil theory, Prandtl-Meyer flow, method of characteristics. Prerequisite: Aro.E. 412.
511. AERODYNAMICS OF A PERFECT FLUID (3) Euler's dynamic equations, complex potential, conformal transformation, thin airfoils, Biot-Savart law; Prandtl three-dimensional airfoil theory. Prerequisite: Aro.E. 412.
512. AERODYNAMICS OF A VISCOUS FLUID (3) Navier-Stokes equations, incompressible and compressible boundary layer theory, jet and wake problems, hydrodynamic stability, turbulence. Prerequisite: Aro.E. 412.
513. RESEARCH IN AERONAUTICAL ENGINEERING (1-15 per semester) Investigation of a theoretical or experimental project in aeronautical engineering.
514. AERONAUTICAL ENGINEERING SEMINAR (1 per semester) Current literature and special problems in aeronautical engineering.
515. AERODYNAMICS (3) Airflow, airplane performance. For students with undergraduate training in science or engineering curriculums other than aeronautical engineering.
516. SPECIAL TOPICS IN AIRCRAFT STRUCTURES (3-9)
519. FLUID DYNAMICS OF ROTATING MACHINERY (3-6) Prerequisite: Aro.E. 412.
520. SPECIAL TOPICS IN AERODYNAMICS (3-9)

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

HOWARD O. TRIEBOLD, *Head of the Department*
109 Frear Laboratories

The department offers graduate work leading to the M.S. and Ph.D. degrees. An entering student should have had courses in mathematics, physics, biological sciences, inorganic chemistry, analytical chemistry, organic chemistry, and physical chemistry equivalent to those required of undergraduate students in the first three years of the agricultural and biological chemistry curriculum. Students who lack some of the prerequisite courses may be admitted for graduate work but are required to take the prerequisite courses without degree credit.

Opportunities for research and graduate study are available in plant metabolism and photosynthesis, intermediary metabolism, nucleic acids, proteins, carbohydrates, lipides, enzymes, vitamins, animal nutrition, poultry nutrition, clinical chemistry, endocrinology, and pesticides.

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

AGRICULTURAL AND BIOLOGICAL CHEMISTRY (AB CH)

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| 403. DAIRY CHEMISTRY (3) | <i>Mr. Shigley</i> |
| 404. FOOD CHEMISTRY (4) | <i>Mr. Triebold</i> |
| 413. PRINCIPLES OF ANIMAL NUTRITION (3) | <i>Mr. Miller</i> |
| 417. METHODS OF AGRICULTURAL ANALYSIS (4) | <i>Mr. Triebold</i> |
| 418. PLANT ANALYSIS (4) | <i>Mr. Clagett</i> |
| 421. CHEMISTRY OF MILLING AND BAKING (3) | <i>Mr. Triebold</i> |
| 425. BIOPHYSICAL CHEMISTRY (4) | <i>Mr. Mallette</i> |
| 426. BIOCOLLOIDS (3) | <i>Mr. Mallette</i> |
| 427. POTENTIOMETRIC THEORY AND TECHNIQUE (3) | |
| 437. GENERAL BIOCHEMISTRY (5) | <i>Mr. Pritham</i> |
| 438. PHYSIOLOGICAL CHEMISTRY (CLINICAL METHODS) (5) | <i>Mr. Pritham</i> |
| 439. PROBLEMS IN AGRICULTURAL CHEMISTRY (3-5) | |
| 440. PLANT BIOCHEMISTRY (3) | <i>Mr. Clagett</i> |
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501. ENZYMES (2) Investigations and theories concerning nature of enzymes, enzyme action, influence of chemical environment on enzyme action, and biological applications. Prerequisite: A.B.Ch. 437. *Mr. Clagett*
502. PHYSICAL CHEMISTRY OF THE CELL (3) Lectures and assigned reading reviewing current literature relative to physical chemistry of living tissues and life processes. Prerequisite: A.B.Ch. 426.
503. BIOCHEMICAL PROBLEMS (1-10 per semester) Prosecution of an assigned problem under the guidance of an instructor.
505. VITAMINS AND DIETARY DEFICIENCY DISEASES (2) Lectures, conferences, and assigned reading. Prerequisite: A.B.Ch. 437. *Mr. Guerrant*
506. VITAMIN ASSAY METHODS (2) Lectures, conferences, and demonstrations dealing with approved methods of vitamin assay and including demonstrations of typical vitamin deficiency syndromes in the rat. Prerequisite: A.B.Ch. 505. *Mr. Guerrant*
- 507a. SEMINAR IN PHYSIOLOGICAL CHEMISTRY AND NUTRITION (1 per semester)
Messrs. Guerrant, Boucher, Miller, and Pritham
- 507b. SEMINAR IN FOODS AND ANALYTICAL CHEMISTRY (1 per semester)
Messrs. Triebold, Althouse, and Shigley
- 507c. SEMINAR IN PLANT, ENZYME, AND INSECTICIDE CHEMISTRY (1 per semester)
Messrs. Frear, Benson, Mallette, and Clagett
508. BIOCHEMICAL LITERATURE (1-3) Assigned readings, reports, and conferences on selected topics in biochemistry. Prerequisite: A.B.Ch. 437.
509. BIOCHEMICAL METHODS (3) Lectures and advanced laboratory on current techniques used in biochemical research. Prerequisites: Phys. 285, Chem. 461.
Messrs. Benson and Mallette
510. PROTEINS, AMINO ACIDS, AND PEPTIDES (2) Organic, physical, and biological chemistry of the naturally occurring compounds of this group. Prerequisites: A.B.Ch. 425, 437. *Mr. Mallette*
511. CARBOHYDRATES (2) Chemical constitution and properties of carbohydrates; their metabolism in plant and animal organisms. Prerequisite: A.B.Ch. 437. *Mr. Benson*

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

512. LIPIDES (2) Investigations on biochemistry of fats and related substances.
Mr. Althouse
513. PHYSICOCHEMICAL MEASUREMENTS USED IN BIOLOGICAL RESEARCH (4) Laboratory course, quantitative in nature, valuable as preparation for A.B.Ch. 502. Hydrogen-ion concentration, electrometric titration, buffers, oxidation-reduction potential, and membrane potential. Prerequisite: A.B.Ch. 425 or Chem. 463.
515. BIOMETRY (2) Application of statistical methods to research problems in biochemistry and biology. Prerequisite: Ag. 400.
Mr. Miller
516. CHEMISTRY OF THE PESTICIDES (2) Lectures and assigned readings on the chemistry of insecticides, fungicides, herbicides, rodenticides, and related materials. Prerequisite: Chem. 31 or A.B.Ch. 437.
Mr. Frear
517. ENDOCRINE SECRETIONS (2) Chemistry of hormones and their physiological significance. Prerequisite: A.B.Ch. 437.
Mr. Pritham
518. MINERAL METABOLISM (2) Utilization and function of mineral elements in animal nutrition. Prerequisite: A.B.Ch. 437.
Mr. Boucher

AGRICULTURAL ECONOMICS

MACKLIN E. JOHN

Head of the Department of Agricultural Economics and Rural Sociology
1 Weaver Hall

A graduate program leading to the M.S. or Ph.D. degree may be taken in agricultural economics. The entering student in the master's program should have as prerequisites 3 credits in agricultural economics, 3 credits in economics, and 3 additional credits in either agricultural economics or economics. If the entering student does not have the prerequisites, they may be taken at this University during the early part of his master's program.

AGRICULTURAL ECONOMICS (AG EC)

- 400, 400X. PUBLIC POLICIES IN AGRICULTURE (1-2)
407. ADVANCED FARM MANAGEMENT (3)
420. AGRICULTURAL PRICES (3)
Mr. Brandow
421. LAND ECONOMICS (3)
Mr. Frey
426. (A.H. 426). LIVESTOCK MARKETING (3)
Mr. Trotter
440. ECONOMICS OF AGRICULTURAL PRODUCTION (3)
500. SEMINAR IN AGRICULTURAL ECONOMICS (1-6) Review of current literature and problems.
503. RESEARCH METHODS IN FARM MANAGEMENT (1-3) Evaluation of research procedures, methods, results, and needs in the field; emphasis on their application to specific research problems. Prerequisites: Ag.Ec. 6, Econ. 14.
504. AGRICULTURAL PRICE AND INCOME POLICY (3) Analysis of farm prices, income consequences for producers and consumers, and effects on resource use; evaluation of policy, considerations in policy making. Prerequisites: Ag.Ec. 420, Econ. 405.
Mr. Brandow

AGRICULTURAL ECONOMICS

505. ADVANCED AGRICULTURAL STATISTICS (3) Multiple correlation, curve fitting, analysis of variance, selection of samples, and other techniques applicable to the rural social sciences. Prerequisite: 3 credits in statistics. *Mr. Bradow*
506. ECONOMIC PROBLEMS IN MARKETING SPECIFIC AGRICULTURAL PRODUCTS (1-4)
507. SEMINAR IN FARM MANAGEMENT (1-6) Special problems relating to organization and operation of the farm business. Prerequisites: Ag.Ec. 6, Econ. 14.
508. CURRENT LITERATURE SEMINAR IN ECONOMICS OF AGRICULTURAL MARKETING (1-3)
510. ADVANCED FARM FINANCE (1-3) Problems and policies in agricultural credit, insurance, and farm financial management.
515. ECONOMIC PROBLEMS IN THE MARKETING OF DAIRY PRODUCTS (3) Economic problems as they are encountered in the process of marketing; particular attention to governmental regulation in pricing and marketing. *Mr. Pierce*
517. PROBLEMS AND POLICIES OF FARMER CO-OPERATIVES (3) Specific types of co-operative organizations, their problems, policies, and progress; relationships existing among co-operatives, between co-operatives and other business organizations, and between co-operatives and the public. Prerequisite: Ag.Ec. 17. *Mr. Becker*
520. FARM PRICE ANALYSIS (3) Econometric analysis of prices, production, and utilization of farm products; review of research in this field. Prerequisites: Ag.Ec. 420, 505; Econ. 405.
522. ADVANCED FARM APPRAISAL (3) Land value theory; methods of land valuation; field practice in farm appraisal.
525. RESEARCH METHODS IN RURAL SOCIAL SCIENCES (2) Scientific method in planning and conducting research. Prerequisite: 9 credits in social sciences. *Mr. John*
526. RESEARCH METHODS IN AGRICULTURAL ECONOMICS (2) Application of economic and statistical principles. *Mr. Baker*

AGRICULTURAL EDUCATION

HENRY S. BRUNNER, *Head of the Department*
101 Agricultural Education Building

Graduate programs are offered which lead to the M.S., M.Ed., D.Ed., and Ph.D. degrees. Minors may be taken in any of the areas of agricultural technology, or, for Master of Science and Doctor of Philosophy degree candidates, in one of the other fields of education, such as educational administration or higher education.

The requirements for admission are 21 semester hours in professional education courses including educational psychology and practice teaching in vocational agriculture, or certification to teach vocational agriculture. Students who lack any part of these requirements may be admitted but are required to fulfill deficiencies without degree credit.

AGRICULTURAL EDUCATION (AG ED)

416v. RURAL EDUCATION (3)

417v, 417vX. RURAL EDUCATION SURVEY (2)

Mr. Brunner

AGRICULTURAL EDUCATION

- 418v, 418vX. SURVEY OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3) *Mr. Brunner*
 420v, 420vX. ADVANCED VISUAL AND OTHER SENSORY AIDS IN TEACHING AGRICULTURE
 (1-6) *Mr. Anthony*
 422v, 422vX. SUPERVISION OF VOCATIONAL EDUCATION IN AGRICULTURE (1-3)
Mr. Anthony
 434v, 434vX. AGRICULTURAL DEVELOPMENTS (1-6) *Mr. Brunner*
- 501v. HISTORY OF AGRICULTURAL EDUCATION (1-3) Development of training for agricultural vocations; emphasis upon introduction of agricultural instruction into the high school program. *Mr. Stevens*
- 502v, 502vX. TEACHING VOCATIONAL AGRICULTURE (1-3) Organization of instruction with respect to vocational objectives, methods of presentation, supervision of practice, pupil evaluation of goals, and follow-up. *Mr. Brunner*
- 503v, 503vX. RESEARCH IN AGRICULTURAL EDUCATION (1-6 per semester) Individual study problems in various phases of agricultural education, such as evaluation of teaching, teaching procedures, and teacher preparation. *Mr. Brunner and Staff*
- 504v. AGRICULTURAL EDUCATION SEMINAR (1 per semester) *Mr. Brunner and Staff*
- 506v, 506vX. PROBLEMS IN COUNTY VOCATIONAL SUPERVISION (1-3) Needs of county supervisors and vocational directors; co-operation with county superintendents, supervisory duties, plans of work, community meetings and organizations.
- 508v. STATE AND COUNTY ADMINISTRATION AND SUPERVISION OF AGRICULTURAL EDUCATION (1-3) Organization and administration of state, county, township, and district systems of agricultural education; state and federal legislation.
- 509v, 509vX. TEACHER TRAINING IN AGRICULTURAL EDUCATION (1-6) Construction of college curriculums, courses of study, and organization of college departments for training agricultural teachers. *Mr. Brunner*
- 520v, 520vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Methods of procedure in investigation and experimentation in education, accompanied by a critical examination of studies made in agricultural education. *Mr. Stevens*
- 521v, 521vX. SCIENTIFIC METHOD IN THE STUDY OF AGRICULTURAL EDUCATION (1-4) Continuation of Ag.Ed. 520v; emphasis upon statistical techniques for students' individual problems. *Mr. Stevens*
- 522v, 522vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) Organization and administration of agricultural education in its local bearings; field laboratory surveys of local school conditions. *Mr. Brunner and Staff*
- 523v, 523vX. FIELD STUDIES IN AGRICULTURAL EDUCATION (1-4) *Mr. Brunner and Staff*
- 524v, 524vX. ANNUAL PLAN OF WORK (1-3) Detailed study of the agricultural education needs of each student's community and outlining annual plans of work. *Mr. Brunner*
- 530v. AGRICULTURAL COLLEGE TEACHING (3) Selection and organization of subject matter for specific courses, methods of learning, teaching devices, technique of teaching, and measurements of results of teaching. *Mr. Brunner*

AGRICULTURAL ENGINEERING

FRANK W. PEIKERT, *Head of the Department*
202 Agricultural Engineering Building

The department offers major work for the M.S. degree with specialization in farm power and machinery, rural electrification, soil and water conservation engineering, and farm structures.

Prerequisite to major work is the completion of an undergraduate curriculum substantially equivalent to that required for the B.S. degree in agricultural engineering at this University.

AGRICULTURAL ENGINEERING (AG E)

400. AGRICULTURAL ENGINEERING PROBLEMS (1-7)

401S. FARM MECHANICS FOR TEACHERS OF VOCATIONAL AGRICULTURE (1½-9)

Unit A. Farm Utilities (1½)

Unit B. Farm Mechanics (1½)

Unit C. Farm Engines (1½)

Unit D. Farm Machinery (1½)

Unit E. Farm Buildings (1½)

Unit F. Soil and Water Structures (1½)

402. FUNCTIONAL DESIGN OF FARM STRUCTURES (3)

405. ADVANCED FARM ELECTRIFICATION (3)

406. ADVANCED DAIRY ENGINEERING (3)

500. ADVANCED ELECTRO-AGRICULTURE (1-6) Investigations in the application of electrical energy to processing, storing, and handling agricultural products. Seminar, written reports.

501. ADVANCED FARM MACHINERY (1-6) Application of agricultural engineering principles to design and operation of farm machinery. Prerequisite: Ag.E. 110.

508. ADVANCED PROBLEMS IN FARM MECHANICS (1-15) Problems in farm shop practice and agricultural engineering related to the farm mechanics program of vocational education in agriculture. Prerequisites: Ag.E. 8, 14; or teaching experience in farm mechanics.

509. RESEARCH IN AGRICULTURAL ENGINEERING (1-4)

AGRONOMY

HOWARD B. SPRAGUE, *Head of the Department*
118 Tyson Hall

The department offers graduate work leading to the M.S. and Ph.D. degrees. Areas of specialization for each degree include soil chemistry, soil conservation, soil classification, soil fertility, soil mineralogy, soil physics, the breeding of corn, small grains and forage plants, forage management, turf management, potato culture, tobacco culture, weed control, and ecology of crops and pastures.

Prerequisites for major work in agronomy vary with the area of specialization, but basic courses in chemistry, mathematics, physics, and biological sciences are re-

AGRONOMY

quired. Students who lack some of the course prerequisites may be admitted but are required to take the prerequisite courses without degree credit.

AGRONOMY (AGRO)

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| 411. BREEDING OF FIELD CROPS (3) | <i>Mr. Cleveland</i> |
| 416. SOIL CLASSIFICATION (5) | <i>Mr. Higbee</i> |
| 419. SOIL PROPERTIES (5) | <i>Mr. Merkle</i> |
| 422. SOIL CONSERVATION (3) | <i>Mr. Kardos</i> |
| 423. PASTURE AND GRASSLAND MANAGEMENT (3) | <i>Mr. Washko</i> |
| 424. FERTILIZER TECHNOLOGY (3) | <i>Mr. Marriott</i> |
| 429. (Bot. 429). WHITE POTATO PRODUCTION (3) | <i>Messrs. Cobb and Mills</i> |
| 490. AGRONOMIC PRACTICES (1-6) | <i>Mr. Washko and Staff</i> |
501. ADVANCED SOIL FERTILITY (4) Interpretation of fertility experiments and diagnosis of soil-plant relationships through field appraisal, analysis, and plant symptoms. Prerequisites: Agro. 31, Bot. 406. Offered in the spring semester of odd years.
Mr. Merkle
503. AGRONOMY SEMINAR (1) Weekly meeting where papers and discussions will be presented by students and staff members. Offered each semester. *Mr. H. B. Sprague*
506. SOIL CHEMISTRY (4) Analyses of important chemical and biochemical reactions occurring in soils, conditions which control these reactions and their importance in soil genesis and plant growth; laboratory work in the more typical and significant analytical procedures; lectures, review of current literature, and practicum. Prerequisites: Agro. 419; A.B.Ch. 417 or Chem. 20. Offered in the spring semester of even years.
Mr. Satchell
507. SOIL PHYSICS (4) Physical properties of the soil; factors affecting them; their measurements, evaluation, and influence in determination of soil productivity. Prerequisites: Agro. 419, Phys. 215, A.B.Ch. 425. Offered in the fall semester of even years.
Mr. Kardos
509. GENETICS OF CROP PLANTS (3) Inheritance in crop plants with particular reference to factor interaction, genetic aspects of linkage and crossing-over, quantitative inheritance, and heterosis. Prerequisite: Bot. 422. Offered in the fall semester of even years.
Mr. Cleveland
510. THE APPLICATION OF CYTOGENETICS TO PLANT BREEDING (3) Cytogenetics, including chromosome structure and behavior, chromosome alterations, polyploidy, interspecific hybridization and their applications to plant breeding. Prerequisite: Bot. 422. Offered in the fall semester of odd years.
Mr. Cleveland
512. FIELD PLOT TECHNIQUE (4) Ramifications of analysis of variance techniques; combining and analyzing data from several experiments; selection of valid error terms. Prerequisite: Math. 8 or Ag. 400. Offered each fall semester. *Mr. Fortmann*
516. HUMUS (2) Origin and chemical nature of soil organic matter, its importance in soil processes, and its decomposition. Prerequisites: Agro. 31, 419. Offered in the fall semester of odd years.
Mr. Richer
517. FARM CROPS ECOLOGY (2) Ecological factors influencing distribution and production of field crops. Prerequisites: Math. 8, Bot. 406. Offered in the fall semester of odd years.

518. GROWTH AND MANAGEMENT OF FORAGE CROPS (3) Factors affecting growth and development of forage crops with particular reference to effects of environment, defoliation, and management practices. Prerequisites: Agro. 423, Bot. 406. Offered in the spring semester of even years.
519. THE NATURE OF SOIL MINERALS (3) Modern methods for identification of the constituent minerals of soils and their relation to soil classification and agricultural practices. Prerequisites: Agro. 1, Chem. 2, Geol. 31. Offered in the spring semester of even years. *Mr. Jeffries*
520. SPECIAL SOILS PROBLEMS (1-6 per semester) Provides basic or practical training in the soils sciences by means of library, field, and laboratory assignments. Offered each semester.
545. THE APPLICATION OF STATISTICS TO FIELD EXPERIMENTS (4) Use of advanced experimental designs in planning, analyzing, and interpreting experiments; includes lattice designs, factorials, confounding, simple and multiple covariance techniques. Prerequisite: Agro. 512. Offered each spring semester. *Mr. Fortmann*
550. SPECIAL CROPS PROBLEMS (1-6 per semester) Provides basic or practical training in the crops sciences by means of library, field, and laboratory assignments. Offered each semester.
582. SEMINAR IN THE BREEDING AND GENETICS OF FARM CROPS (1-8 per semester) Offered each semester.
- 583S. LABORATORY METHODS IN AGRONOMIC RESEARCH (3) Prerequisite: Agro. 512. Offered each summer.

ANIMAL HUSBANDRY

GLENN R. KEAN, *Acting Head of the Department*
203 Armsby Hall

The department offers major work for the M.S. and Ph.D. degrees with specialization in animal production, animal breeding, and meats.

The prerequisite to major graduate work in animal husbandry is the completion of an undergraduate curriculum substantially equivalent to that recommended for pre-graduate training in the animal husbandry curriculum at this University.

ANIMAL HUSBANDRY (A H)

421. ADVANCED MEAT STUDIES (3) *Mr. Ziegler*
423. ADVANCED STOCK JUDGING (2)
424. ANIMAL HUSBANDRY SEMINAR (1)
426. (Ag.Ec. 426). LIVESTOCK MARKETING (3)
431. ADVANCED MEAT JUDGING (2)
500. SEMINAR IN ANIMAL HUSBANDRY (1-6)

501. PEDIGREE STUDY (1-6) Research work in breed study history, and analytical study of breed pedigrees, and a complete survey of the herd, flock, or stud book.

ANIMAL HUSBANDRY

502. RESEARCH IN MEATS (1-6 per semester) Investigation of methods for handling, cutting, processing, freezing, and curing meat and meat products. Prerequisite: A.H. 421. *Mr. Ziegler*
503. LIVESTOCK MANAGEMENT (3) Handling of purebred herds and flocks; relation of livestock breeders to the public and methods of developing purebred herds and flocks through careful breeding.
505. ADVANCED ANIMAL BREEDING (1-5) Special problems in animal genetics as applied to breeding and improvement of horses, cattle, sheep, and swine. Prerequisites: A.H. 22, Bot. 22.

ANIMAL NUTRITION

RAYMOND W. SWIFT, *Head of the Department*
21 Armsby Hall

The M.S. and Ph.D. degrees are offered with a major in animal nutrition. For admission a student must have had A.Ntr. 401 and 402 or their equivalent and must have met the requirements for graduate work in agricultural and biological chemistry. Specialized training is offered in the area of energy metabolism. Candidates select courses for this major from a number of related fields.

ANIMAL NUTRITION (A NTR)

401. PHYSIOLOGY OF NUTRITION (3) *Mr. Barron*
402. PHYSIOLOGY OF NUTRITION (3) *Mr. French*

ANTHROPOLOGY

WILLIAM G. MATHER, *Head of the Department of Sociology*
203 Sparks Building

No advanced degree is offered in this field, but a candidate with a major in another field may choose a minor in anthropology with the approval of his major department.

ANTHROPOLOGY (ANTHY)

443. ANTHROPOLOGY OF THE OLD WORLD (3) *Mr. Mook*
445. PRIMITIVE SOCIETY (3) *Mr. Mook*
540. THEORY AND METHOD IN ANTHROPOLOGY (3) Theory and method used in culture-historical, sociological, and psychological interpretations. *Mr. Mook*
545. SEMINAR IN ANTHROPOLOGY (1-9) Critical analysis of research in selected areas of regional ethnography and ethnological theory. Prerequisites: Anthy. 45, 445. *Mr. Mook*

ARCHITECTURE

MILTON S. OSBORNE, *Head of the Department*
302 Main Engineering Building

The department offers graduate work leading to the M.S. degree with a major in architecture. For entering graduate work in this field, a degree of Bachelor of Architecture, Bachelor of Science in Architecture, or Bachelor of Fine Arts in a five-year curriculum in architecture is required.

The department also offers graduate work leading to the M.S. degree with a major in architectural engineering. For entering graduate work in this field, a degree of Bachelor of Architectural Engineering or Bachelor of Science in Architectural Engineering is required.

The entering student's record should include the courses, or equivalents, required by this University for the baccalaureate degree in the field designated for graduate study.

ARCHITECTURE (ARCH)

- 410. ADVANCED ARCHITECTURAL DESIGN (2-12) *Mr. Osborne and Staff*
- 411. ADVANCED ARCHITECTURAL DESIGN (8)
- 412. ADVANCED ARCHITECTURAL DESIGN AND THESIS (8)
- 421. (A.A.H. 421). CONTEMPORARY ARCHITECTURE (3)
- 501. ARCHITECTURAL DESIGN (4-8) Problems in advanced planning and design, including study of group composition. Practicum and seminar. *Mr. Osborne and Staff*
- 502. ARCHITECTURAL RESEARCH (2-12) Prosecution of assigned problems under the guidance of an instructor. *Mr. Osborne and Staff*
- 503. ARCHITECTURAL HISTORY RESEARCH (3-12) Original research in architectural history. Seminar and written reports. *Mr. Dickson and Staff*

ARCHITECTURAL ENGINEERING (A E)

- 401. ARCHITECTURAL ENGINEERING (3)
- 402. ARCHITECTURAL ENGINEERING (4)
- 403. ARCHITECTURAL ENGINEERING (3)
- 420. ARCHITECTURAL ENGINEERING (3)
- 421. ARCHITECTURAL ENGINEERING (4)
- 422. ARCHITECTURAL ENGINEERING (3)
- 423. ARCHITECTURAL ENGINEERING THESIS (2)
- 424. ARCHITECTURAL ENGINEERING THESIS (5)
- 502. ARCHITECTURAL ENGINEERING (3-8) Advanced structural design in steel and reinforced concrete. Lectures and class criticism. Practicum and seminar. *Mr. Richardson and Staff*
- 503. ARCHITECTURAL ENGINEERING (4-8) Continuation of A.E. 502 in which problems of wind bracing in tall buildings, rigid frames, and heavy-framed constructions are studied. Practicum and seminar. *Mr. Richardson and Staff*
- 504. ARCHITECTURAL ENGINEERING (4-8) Statically indeterminate stresses in steel and reinforced concrete buildings; area moment, slope deflection, and moment distribution methods. Recitation and seminar. *Mr. Richardson and Staff*

ART

ALBERT CHRIST-JANER, *Acting Head of the Department*
209 Sparks Building

The department offers graduate work leading to the M.A. degree. Students may specialize in studio work or the history of art and architecture, or may combine the two areas to satisfy the major requirements.

For admission at least 18 credits of undergraduate work in art are required. The graduate program is contingent upon the student's undergraduate preparation. If an inadequacy exists, the student will be required to make up the deficiency without degree credit.

ART (ART)

- 400. OIL PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-12)
- 403S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Mr. Dickson*
- 404S. COMPARATIVE HISTORY AND APPRECIATION OF ART (3) *Mr. Dickson*
- 410. WATER-COLOR PAINTING: LANDSCAPE, STILL LIFE, AND FIGURE (3-9)
- 420. APPLIED DESIGN (3-9)
- 442S. ART OF THE MIDDLE AGES AND RENAISSANCE IN ITALY (3)
- 443S. ART IN AMERICA (3)
- 444S. ART IN NORTHERN EUROPE (3)
- 490. LIFE DRAWING (3)

- 500. ART RESEARCH (2-6) Prosecution of assigned problems under the guidance of an instructor.

ART AND ARCHITECTURAL HISTORY (A A H)

- 421. (Arch. 421). CONTEMPORARY ARCHITECTURE (3)
- 448. HISTORY OF PRINTS AND DRAWINGS (3)

- 501. ITALIAN PAINTING (2-6) Investigations of early Italian painting. Seminar, written reports. *Mr. Dickson*
- 502. MEDIEVAL SCULPTURE (2-6) Sculpture of Italy and France from the 9th to the 13th centuries. Seminar, written reports. *Mr. Norton*
- 503. ART HISTORY RESEARCH (3-12) Original investigation in art history, to be pursued independently or concurrently with course work in particular fields. Prerequisite: 6 credits in history of art.
- 504. SEMINAR: ART LITERATURE AND ICONOGRAPHY (2-6) Methods of research in the fine arts; survey of the literature of art; studies in iconography. Prerequisite: 6 credits in history of art.

ART—MUSIC—THEATRE (A M T)

- 400. CONTEMPORARY FORMS IN ART, MUSIC, THEATRE I (3)
- 401. CONTEMPORARY FORMS IN ART, MUSIC, THEATRE II (3)

ART EDUCATION

VIKTOR LOWENFELD, *Head of the Department*
207B Burrowes Building

The department offers advanced work leading to the M.Ed., M.S., D.Ed., and Ph.D. degrees. It is generally expected that students admitted to work toward a master's degree have one year of teaching experience and present the equivalent of an approved four-year art education curriculum. A student cannot receive his doctor's degree without having had at least two years of successful teaching experience.

ART EDUCATION (A ED)

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| 402. PROFESSIONAL ORIENTATION OF THE ART TEACHER (3) | <i>Mr. Mattil</i> |
| 404. METHODS OF GRAPHICS AND ILLUSTRATIONS (3) | |
| 414, 414X. ADVANCED CRAFTS FOR TEACHERS (3-6) | <i>Mr. Beittel</i> |
| 420. CERAMICS FOR TEACHERS (3) | |
| 434, 434X. ART APPRECIATION IN THE EDUCATIONAL PROGRAM (3) | <i>Mr. Beittel</i> |
| 434b, 434bX. ART IN THE ELEMENTARY SCHOOL (2-3) | <i>Mr. Lowenfeld</i> |
| 434c, 434cX. ART IN THE SECONDARY SCHOOL (3) | <i>Mr. Mattil</i> |
| 434d. ART SUPERVISION (3) | <i>Mr. Mattil</i> |
| 486, 486X. CURRENT PROBLEMS IN ART EDUCATION (2-3) | <i>Mr. Mattil</i> |
| 487. MURAL PAINTING IN SCHOOLS (3) | <i>Mr. Lowenfeld</i> |
| 488. ADVANCED MURAL PAINTING IN SCHOOLS (3) | <i>Mr. Lowenfeld</i> |
| 489. ART EXPERIENCES WITH CHILDREN (3) | |
| 504. ADVANCED METHODS IN GRAPHIC PROCESSES (3) Exploration through laboratory experience of printing method; etching, silk screen, linoleum, or other. Applications in teaching. | |
| 514. FUNCTIONAL RELATIONSHIPS IN CRAFTS (3) Relationships of material design and purpose in crafts discussed by means of outstanding products of different materials, periods, and cultures. Prerequisite: 6 credits in crafts or 3 in design and 3 in advanced crafts. | |
| 516. ANALYSIS OF THREE-DIMENSIONAL PROCESSES IN ART (3) Three-dimensional processes analyzed with regard to kinetic, textural, form, and other functions. | |
| 534. CREATIVE ART ACTIVITY FOR THE HANDICAPPED (3) Specific methods for development of creative art activity with the physically, mentally, emotionally, and socially handicapped; adjustive effect upon them. Prerequisite: 6 credits in art education or 6 in special education or 6 in psychology. | <i>Mr. Lowenfeld</i> |
| 586. RESEARCH IN ART EDUCATION (3-9) Current experiments in art education; required of students working for a master's degree in art education. | <i>Mr. Beittel</i> |
| 588. HISTORY OF ART EDUCATION (3) Historical development of philosophies in art education in the United States and abroad. | <i>Mr. Lowenfeld</i> |

BACTERIOLOGY

ROBERT W. STONE, *Head of the Department*
204 Patterson Hall

The department offers graduate work leading to the M.S. and Ph.D. degrees. Specialized areas of study include bacterial physiology, soil microbiology, food and in-

BACTERIOLOGY

dustrial microbiology, immunology, and virology. There is opportunity for research in animal disease in co-operation with the Department of Veterinary Science.

Prerequisites for graduate work include 20 semester hours of chemistry including quantitative analysis and organic chemistry, and 20 semester hours of biological science including 8 hours of microbiology. It is possible to substitute additional chemistry credits for part of the biology requirement.

BACTERIOLOGY (BACT)

- 401. GENERAL MICROBIOLOGY (4)
- 407. BACTERIOLOGY PROBLEMS (2-9)
- 410. IMMUNOLOGY AND SEROLOGY (4)
- 411. BACTERIOLOGICAL SURVEY (1)
- 412. ADVANCED BACTERIOLOGY (4)
- 413. SOIL MICROBIOLOGY (3)
- 414. FOOD MICROBIOLOGY (4)
- 416. INDUSTRIAL MICROBIOLOGY (4)

- 506. RESEARCH (1-15 per semester) Special problems in microbiology.
- 507. SEMINAR (1 per semester) Reports on current fields of research.
- 508. PHYSIOLOGY OF BACTERIA (2) Composition, nutrition, and growth of microorganisms; influence of physical and chemical environment on metabolism.
- 508a. LABORATORY IN PHYSIOLOGY OF BACTERIA (2) Laboratory work to accompany the lectures given in Bact. 508.
- 509. FERMENTATION (2) Chemical activities of microorganisms; mechanisms of fermentative and oxidative metabolism.
- 510. LABORATORY IN FERMENTATION (2) Laboratory procedures and problems in fermentation to accompany Bact. 509.
- 512. BACTERIOLOGICAL TECHNIQUES (1-6) Practice in special laboratory techniques including manometry, tissue culture, and serology.
- 515. (V.Sc. 515). VIROLOGY (2-4) Rickettsial and viral agents parasitizing man, animals, and microorganisms. Prerequisite: Bact. 410.
- 516. BACTERIAL GENETICS (2-4) Mechanisms of variation in microorganisms including mutation, adaptation, sexual recombination, transduction, and transforming factors. Prerequisite: 3 credits each in bacteriology and genetics.

BIOLOGICAL SCIENCE

HENRY W. POPP, *Chairman of the Committee on Biological Science*
206 Buckhout Laboratory

The M.Ed. degree is offered with a major in biological science. The program is designed to meet the needs of secondary school science teachers and consists of at least 24 credits chosen from agricultural and biological chemistry, bacteriology, botany, entomology, and zoology, and a minor of at least 6 credits in basic education.

A candidate for the M.Ed. degree is expected to complete at least one course in each of the basic sciences and at least 12 credits in one of them. In order to enter a program for a higher degree with a major in biological science, the candidate should present 24 credits in the biological sciences and 27 credits in education, including educational psychology and practice teaching.

As many as 6 credits may be made up as undergraduate deficiencies after the candidate is admitted to the Graduate School.

The M.S. degree is offered in agricultural and biological chemistry, bacteriology, botany, entomology, plant pathology, and zoology, but not in the broad field of biological science.

BOTANY

HENRY W. POPP

Head of the Department of Botany and Plant Pathology
206 Buckhout Laboratory

The M.S. and Ph.D. degrees are offered in the field of botany. The student majoring in botany may specialize in any one of the branches of this subject, such as plant anatomy, cytology, ecology, genetics, morphology, mycology, physiology, and taxonomy. In order to enter graduate work in this field, a student should present 27 credits of undergraduate work in botany or 21 credits in botany and 6 in biological science. As many as 6 credits may be made up as undergraduate deficiencies after the candidate has been admitted to the Graduate School.

See also Plant Pathology.

BOTANY (BOT)

405. (Zool. 405). GENERAL CYTOLOGY (3)	Mr. Grun
406. PLANT PHYSIOLOGY (4)	Mr. Fritz
407. PLANT ANATOMY (3)	Mr. Kribs
408. PLANT PATHOLOGICAL TECHNIQUES (3)	Mr. Bloom
409. PLANT ECOLOGY (3)	Mr. Kovar
412. ADVANCED FOREST PATHOLOGY (3)	Mr. Fergus
414, 414X. TAXONOMY OF VASCULAR PLANTS (3)	Mr. Wahl
415. MORPHOLOGY OF THE ALGAE (3)	Mr. Wahl
416. MORPHOLOGY OF THE BRYOPHYTES (2)	Mr. Grove
417. MORPHOLOGY OF THE TRACHEOPHYTES EXCLUSIVE OF ANGIOSPERMS (3)	Mr. Grove
418. BOTANICAL PROBLEMS (1-6)	Mr. Popp and Staff
419. MYCOLOGY (3)	Mr. Fergus
420. MORPHOLOGY OF THE ANGIOSPERMS (3)	Mr. Grove
421. BOTANICAL TECHNIQUE (3)	Mr. Grove
422. (Zool. 422). ADVANCED GENETICS (3)	Messrs. Wright, Grun, and Mitchell
424. COMMERCIAL TROPICAL WOODS (3)	Mr. Kribs
427. ADVANCED SYSTEMATIC BOTANY (1-6)	Mr. Wahl
428. ADVANCED PLANT PATHOLOGY (2)	Mr. Bloom
429. (Agro. 429). WHITE POTATO PRODUCTION (3)	Mr. Mills
433S. (Zool. 433S). GENETICS, EUGENICS, AND EVOLUTION (3)	Messrs. Wright, Grun, and Mitchell

BOTANY

500. PLANT PHYSIOLOGY SEMINAR (1 per semester) Selected topics from recent literature; staff and student reports on current research. *Messrs. Popp and Fritz*
501. THE PHYSIOLOGY OF THE FUNGI (3) Chemical composition, metabolism, toxic and stimulating agencies, spore germination, growth and irritability of the fungi. Prerequisites: Bot. 406, 419, and preferably Chem. 32. *Mr. Fergus*
505. (Zool. 505). CYTOLOGY AND CYTOGENETICS (3) Chromosome mechanism of heredity; relationship between plant and animal evolution and breeding and changes in chromosomes; cytological and cytochemical techniques. Prerequisite: Bot. 22 or Zool. 22. *Mr. Grun*
506. COMPARATIVE ANATOMY OF VASCULAR PLANTS (3) Structure of the Tracheophyta from a phylogenetic standpoint. Prerequisite: Bot. 407. *Mr. Kribs*
508. PROBLEMS IN GENETICS (2-6) Problems to suit needs of individual students; conferences and laboratory work. Prerequisite: Bot. 422. *Messrs. Wright, Grun, and Mitchell*
509. PHYSIOLOGY OF PATHOGENICITY (3) Physiological processes of plant pathogenic bacteria and fungi occurring during incubation, ingress, and infection. Prerequisite: Bot. 10, 11, or 419. *Mr. Schein*
511. PHYSIOLOGY OF PLANT GROWTH AND DEVELOPMENT (2-4) Prerequisite: Bot. 406. *Mr. Popp*
512. PHYSIOLOGY OF PLANT METABOLISM (2-4) Prerequisite: Bot. 406. *Mr. Fritz*
513. WATER AND MINERAL RELATIONS OF PLANTS (2-4) Absorption of water and minerals; transport of materials within the plant; physiology of transpiration. Prerequisite: Bot. 406. *Mr. Fritz*
515. DISEASE RESISTANCE IN PLANTS (2-4) Stability of resistance, selection of resistant material, economics of control, special problems. Prerequisites: Bot. 22 or 33; 10. *Messrs. Wernham and Mills*
518. BOTANICAL PROBLEMS (1-15 per semester) *Mr. Popp and Staff*
519. PLANT VIRUSES (3) Nature, symptomatology, transmission, and control of virus diseases of plants. *Mr. Boyle*
520. PLANT PATHOGENIC BACTERIA (3) Bacteria causing plant diseases; methods of identification, inoculation, and control. *Mr. Kneebone*
521. MOLDS, YEASTS, AND ACTINOMYCETES (3) Morphology and taxonomy of fungi important in microbiology; identification and techniques of study. *Mr. Fergus*
522. MYXOMYCETES, PHYCOMYCETES, AND ASCOMYCETES (4) Morphology, taxonomy, phylogeny, and life histories; identification and field work. Prerequisite: Bot. 419. *Mr. Fergus*
523. BASIDIOMYCETES AND FUNGI IMPERFECTI (4) Morphology, taxonomy, phylogeny, and life histories. Prerequisite: Bot. 419. *Mr. Fergus*
524. (Zool. 524). SEMINAR IN GENETICS (1 per semester) *Messrs. Wright, Grun, and Mitchell*
- 525a, 525b. STRUCTURE OF ECONOMIC PLANTS (3-6) Developmental and reproductive features of (a) field and vegetable crops, (b) fruit crops. Bot. 525a is offered in

the spring semester of odd years, 525b in the spring semester of even years.

Mr. Grove

526. PHOTOMICROGRAPHY OF PLANT TISSUES (2) Prerequisite: Bot. 421 or Zool. 31 or W.U. 37. *Mr. Kribs*

527aS-527bS. PLANT BIOLOGY (3 each) (a) Structure and physiology; (b) reproduction processes, development and relationships of plant groups. Methods of obtaining materials and setting up experiments. Given in alternate years. Prerequisite: general biology or general botany courses.

528. (Zool. 528). POPULATION GENETICS (3) Factors affecting gene frequency, genotype frequency, genotype-environmental interaction, and genetic relationship in natural and artificial populations. *Mr. Mitchell*

529. DISEASES OF FORAGE CROPS (3) Etiology, symptomatology, and epidemiology of the more important diseases of forage grasses and legumes; critical evaluation of techniques of control. *Mr. Couch*

530. PLANT DISEASE CONTROL (3) Methods, and laboratory and field testing of materials used in plant disease control. *Mr. Fink*

531. PLANT PATHOLOGY SEMINAR (1 per semester) Selected topics of current research, history, and contemporary trends in plant pathology.

537S. (Ed. 537S, Zool. 537S). WORKSHOP IN THE BIOLOGICAL SCIENCES (3) Projects designed for teachers of biology in the secondary schools.

BUSINESS ADMINISTRATION

G. K. NELSON

In Charge of Graduate Programs in Business Administration
108 Sparks Building

Programs are offered leading to the M.S. and Ph.D. degrees with a major in business administration. Students may specialize in accounting, banking and finance, insurance and real estate, management, marketing, or trade and transportation. There is also a general major at the master's level for students whose undergraduate training was in a field other than business administration.

A minimum of 18 acceptable undergraduate credits in the fields of accounting, commerce, economics, and business statistics—including at least 6 in economics and 3 in business statistics—is required. An applicant who is slightly deficient in the required course work may be admitted with specific deficiencies which are to be made up without degree credit. Prerequisites to any graduate courses to be scheduled will also be considered to be deficiencies. An applicant with little or no undergraduate training in the field of business administration may enroll as an undergraduate student for one or more semesters and then be admitted to the Graduate School if his record is satisfactory.

ACCOUNTING (ACCTG)

400. CONTROLLERSHIP (3) *Mr. G. K. Nelson*
401. ADVANCED ACCOUNTING (3) *Mr. Schrader*
403. ADVANCED AUDITING (3-9) *Mr. Rowland*

BUSINESS ADMINISTRATION

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| 404. BUDGETARY CONTROL (3) | <i>Mr. G. K. Nelson</i> |
| 405. ADVANCED COST ACCOUNTING (3) | <i>Mr. G. K. Nelson</i> |
| 406. ADVANCED FEDERAL TAX ACCOUNTING (3) | <i>Mr. Rowland</i> |
| 407. C.P.A. REVIEW (3) | <i>Mr. Rowland</i> |
| 408. GOVERNMENTAL ACCOUNTING (3) | <i>Mr. Rowland</i> |

500. ACCOUNTING SEMINAR (3) Prerequisite: Acctg. 6.

501. ACCOUNTING SYSTEMS (3) Principles of system design including practical application to special businesses, such as financial institutions, department stores, public utilities, etc. Prerequisite: Acctg. 401.

520. PROBLEMS IN ACCOUNTING (3-6) Planned individual projects involving library, laboratory, or field work.

BUSINESS STATISTICS (B S)

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| 500. SEMINAR IN BUSINESS STATISTICS (3) | <i>Mr. Saylor</i> |
| 501. ADVANCED BUSINESS STATISTICS (3) | <i>Mr. Saylor</i> |

COMMERCE (COM)

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| 405. ANALYSIS OF FINANCIAL STATEMENTS (3) | <i>Mr. Bradley</i> |
| 406. INVESTMENT ANALYSIS (3) | <i>Mr. Malott</i> |
| 407. INVESTMENT BANKING (3) | <i>Mr. Bradley</i> |
| 415. REGULATION OF TRANSPORT CARRIERS (3) | <i>Mr. Pashek</i> |
| 416. PROBLEMS IN TRADE AND TRANSPORTATION (3) | <i>Mr. Waters</i> |
| 417. FOREIGN MARKETS (3) | <i>Mr. Mares</i> |
| 424. MARKETING RESEARCH (3) | <i>Mr. Babione</i> |
| 427. RETAIL BUYING AND MERCHANDISING (3) | <i>Mr. Einstein</i> |
| 428. RETAIL ADVERTISING AND SALES PROMOTION (3) | <i>Mr. Einstein</i> |
| 430. ADVANCED BUSINESS LAW (3) | <i>Mr. Phalan</i> |
| 434. ADVANCED PROPERTY AND CASUALTY INSURANCE (3) | <i>Mr. Lucas</i> |
| 435. ESTATE PLANNING (3) | <i>Mr. Williams</i> |
| 436. FUNDAMENTALS OF SALES MANAGEMENT (3) | <i>Mr. Decker</i> |
| 437. CASE STUDIES IN MARKETING (3) | <i>Mr. Babione</i> |
| 455. CASES IN PUBLIC RELATIONS (3) | <i>Mr. Wherry</i> |
| 477. ADMINISTRATIVE MANAGEMENT (3) | <i>Mr. Hurley</i> |

500. CASE STUDIES IN BUSINESS ADMINISTRATION (3) Case studies of business and management policy with respect to procurement, production, selling, finance, accounting, relations with government, labor, and the public. *Mr. Waters*

501. COMMERCE SEMINAR (3-6) Reports on research in selected fields of commercial activities.

502. SEMINAR IN BUSINESS MANAGEMENT (3-6) *Mr. Waters*

503. TRANSPORTATION AND PUBLIC UTILITY SEMINAR (3-6) *Mr. Cook*

504. PROBLEMS IN COMMERCE (3-6) Planned individual projects involving library, laboratory, or field work. *Mr. Leffler*

506. SEMINAR IN INVESTMENTS AND CORPORATION FINANCE (3-6) *Mr. Leffler*

517. INTERNATIONAL BUSINESS PRACTICES (3) Practices of exporters and importers dealing in commodities traded in world markets under competition, monopoly, or governmental control. Prerequisite: Com. 17. *Mr. Hench*
523. SEMINAR IN MARKETING (3-6) Research in modern marketing trends. *Mr. Babione*
525. CASE STUDIES IN INSURANCE (3-6) Analysis of management's insurance problems, such as the feasibility of self-insurance; proper allocation of insurance premiums and coverage in selected industries, etc. Prerequisites: Com. 25, 33. *Mr. Wherry*
536. SALES MANAGEMENT SEMINAR (3) Principles of sales planning and administration; co-ordination of selling with advertising, promotion, production, and accounting; use of market research selling costs and budgets.

CERAMIC TECHNOLOGY

G. W. BRINDLEY, *Head of the Department*
214 Mineral Industries Building

The M.S. and Ph.D. degrees are offered in ceramic technology. The background required for admission is a bachelor's degree in ceramics or in one of the related physical sciences. A knowledge of differential and integral calculus is required together with adequate physics and chemistry.

In view of the wide field covered by ceramic technology, the graduate courses may be selected with a bias toward physical ceramics, chemical ceramics, or glass technology. This makes it easily possible for students whose major subject for the B.S. or M.S. degree has been either physics or chemistry to take up appropriate graduate studies in ceramic technology.

CERAMIC TECHNOLOGY (CER T)

400. SPECIAL TOPICS (1-2)
401. CERAMIC BODIES AND GLAZES (3) *Mr. Hummel*
402. PRINCIPLES OF CERAMIC ENGINEERING (3)
403. CERAMIC ENGINEERING PROCESSES AND EQUIPMENT (3)
404. CERAMIC SEMINAR (1)
405. CERAMIC RESEARCH AND DESIGN (3)
411. THEORY OF CERAMIC PROCESSES (2) *Mr. Buessem*
- 413, 413X. CERAMIC PETROGRAPHY (3)
415. GLASS AND ENAMELS (3) *Mr. Ehman*
416. ADVANCED GLASS TECHNOLOGY (3) *Messrs. Weyl and Rindone*
420. REFRACTORIES (3) *Mr. McQuarrie*
500. SEMINAR IN CERAMIC TECHNOLOGY (1-2 per semester) Current developments in ceramic technology and related fields. Required of all graduate students in ceramic technology. *Mr. Brindley and Staff*
501. COLLOIDAL BEHAVIOR OF CLAYS AND MUDS (2-4) Colloidal properties of ceramic clays, glazes, drilling muds, filtering and bleaching clays, and kindred systems. *Mr. Taylor*

CERAMIC TECHNOLOGY

503. USE OF PHASE EQUILIBRIA DATA IN CERAMIC TECHNOLOGY (2-5) Phase equilibria in unary, binary, ternary, and other systems; applications in product development and in understanding behavior of ceramic materials. *Mr. Hummel*
506. MECHANICAL PROPERTIES OF CERAMIC MATERIALS (2-3) Experimental stress-strain-time relations in elasticity, anelasticity, plasticity, and rupture; theory of strength and control. *Mr. Buessem*
507. THERMAL PROPERTIES OF CERAMIC MATERIALS (2-3) Heat capacity, heat of fusion, thermal conductivity, and thermal expansion in relation to macroscopic measurements and basic atomic concepts applied to ceramic materials. *Mr. McQuarrie*
508. DIELECTRIC AND MAGNETIC PROPERTIES OF CERAMIC MATERIALS (2-3) Preparation and properties of ceramic semi-conductors, dielectrics, and magnetic materials. *Mr. Buessem*
510. SEMINAR IN GLASS TECHNOLOGY (1-2 per semester) Current developments in glass technology and related fields. *Mr. Weyl and Staff*
511. CHEMICAL ASPECTS OF THE CONSTITUTION OF GLASS (1-3 per semester) Historical development, properties, and atomistic interpretation for changes of properties with compositions, temperature, and past history. *Mr. Weyl*
512. PHYSICAL ASPECTS OF THE CONSTITUTION OF GLASS (1-3) Atomic structure of glass, its relation to physical properties; rheology; glass as a liquid. *Mr. Brindley*
515. SPECIAL PROBLEMS IN CERAMIC TECHNOLOGY (1-6 per semester) Advanced individual study on a problem in ceramics.
516. SELECTED TOPICS IN CERAMIC TECHNOLOGY (1-3 per semester) Intensive group study of special topics.
517. RESEARCH INSTRUMENTS AND EQUIPMENT (2) Applications of fundamental laws and principles in research instruments; care, adjustment, and effective use of instruments and equipment (demonstrations).
530. (Min. 530). STRUCTURE, PROPERTIES, AND OCCURRENCE OF CLAY MINERALS (2-5) Structure analysis and identification of clay minerals; mineral transformation and behavior; occurrence, genesis, and petrography of fine-grained sediments. *Messrs. Brindley, Bates, and Griffiths*

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in ceramic technology studies are listed under Mineral Sciences in Part II of this bulletin.

CHEMICAL ENGINEERING

DONALD S. CRYDER, *Head of the Department*
102 Walker Laboratory

The department offers graduate work leading to the M.S. or Ph.D. degrees. The minimum undergraduate requirements for admission are 24 semester hours of chemical engineering including stoichiometry, industrial chemistry, unit operations, thermodynamics, plant design, kinetics, or chemical engineering problems; 14 semester

CHEMICAL ENGINEERING

hours of engineering including engineering mechanics, electrical engineering, or mechanical engineering basic courses; chemistry through one year of physical chemistry; and mathematics through differential equations.

CHEMICAL ENGINEERING (CH E)

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| 402. CHEMICAL ENGINEERING (4) | <i>Mr. Carnahan</i> |
| 403. CHEMICAL ENGINEERING (4) | <i>Mr. Carnahan</i> |
| 404. CHEMICAL PLANT DESIGN (3) | <i>Mr. Williams</i> |
| 405. THERMODYNAMICS FOR CHEMICAL ENGINEERS (3) | <i>Mr. Cannon</i> |
| 422. MOTOR FUELS (2) | <i>Mr. Carnahan</i> |
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| 500. SEMINAR IN CHEMICAL ENGINEERING (1) | Required of all graduate students. |
| 510. ADVANCED HEAT TRANSFER I (3) | Physical and chemical factors controlling the rate of heat transfer under conditions of steady flow.
<i>Mr. Cryder</i> |
| 511. ADVANCED HEAT TRANSFER II (3) | Flow of heat under varying temperature conditions.
<i>Mr. Cryder</i> |
| 515. DISTILLATION (3) | Commercial distillation, equilibrium diagrams, vapor composition, stills and rectifying and stripping columns.
<i>Mr. Carnahan</i> |
| 516. ECONOMIC BALANCE (3) | Problem work on the design of chemical engineering equipment from the economic standpoint.
<i>Mr. Cannon</i> |
| 518. CHEMICAL ENGINEERING DESIGN (3) | Complicated examples are discussed and worked out. Several different unit operations will be combined for the design of a complete installation. |
| 524. CHEMICAL ENGINEERING, APPLICATION OF THERMODYNAMICS (3) | Elements of thermochemistry and thermodynamics of greatest importance in chemical engineering.
<i>Mr. Cannon</i> |

CHEMISTRY

W. CONARD FERNELIUS, *Head of the Department*
212 Whitmore Laboratory

The department offers graduate work leading to the M.S. and Ph.D. degrees. Students may specialize in analytical, inorganic, organic, physical, and petroleum chemistry. The general facilities for instruction and research in the major fields of chemistry are excellent, while the cryogenic, microscopy, petroleum, radiochemical, and spectroscopy laboratories provide a number of unusual features.

Entering graduate students should have had training which includes at least one year's work in each of the following: general chemistry, analytical chemistry, organic chemistry, physical chemistry, and general physics. Mathematics through integral calculus is required, and a reading knowledge of at least one foreign language, preferably German, is expected.

Prior to scheduling their first semester's program, new students will take examinations in the four areas of analytical, inorganic, organic, and physical chemistry. The information obtained from these tests will assist both the student and his adviser in

CHEMISTRY

making up a program best suited to the entering student's needs. These examinations are normally given just prior to the regular registration period.

CHEMISTRY (CHEM)

400. CHEMICAL LITERATURE (1) *Mrs. Strauss*
 405. NUCLEAR AND RADIOCHEMISTRY (3) Breakage ticket \$5. *Messrs. Currie and Miller*
 410. ADVANCED INORGANIC CHEMISTRY (4) Breakage ticket \$5.
 411-412. FLUORINE CHEMISTRY (3 each)
 413. INORGANIC PREPARATIONS AND LABORATORY METHODS (2-5) Breakage ticket \$5. *Mr. Block*
 420. ADVANCED ANALYTICAL CHEMISTRY (4) Breakage ticket \$10.
 426. INSTRUMENTAL METHODS OF ANALYSIS (3-5) Breakage ticket \$10. *Messrs. Hayes, Jordan, and Schempf*
 434. QUANTITATIVE ORGANIC ANALYSIS (3-5) Breakage ticket \$10. *Messrs. Hayes, Jordan, and Schempf*
 435. ORGANIC PREPARATIONS AND LABORATORY METHODS (3-5) Breakage ticket \$10. *Mr. Oakwood*
 436. ORGANIC CHEMISTRY OF NATURAL PRODUCTS (3) *Mr. Aston*
 437. QUALITATIVE ORGANIC ANALYSIS (3) Breakage ticket \$5. *Messrs. Oakwood and Noll*
 440-441. ADVANCED PHYSICAL CHEMISTRY (3 each) *Messrs. Hutchison and Seward*
 448. COLLOID CHEMISTRY (3) Breakage ticket \$5. *Mr. Hutchison*
 *460-461. INTRODUCTORY PHYSICAL CHEMISTRY (3 each)
 *462. EXPERIMENTAL PHYSICAL CHEMISTRY (1) Breakage ticket \$5.
 *463. EXPERIMENTAL PHYSICAL CHEMISTRY (1) Breakage ticket \$5.
 *464-465. PHYSICAL CHEMISTRY (3 each)
 470. CHEMICAL MICROSCOPY (3) Breakage ticket \$5. *Miss Willard*
 471. ADVANCED CHEMICAL MICROSCOPY (3) Breakage ticket \$5. *Miss Willard*
 472. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$5. *Mr. Fleming*
 473. TEXTILE MICROSCOPY (3) Breakage ticket \$5. *Miss Willard*
 474. QUANTITATIVE ORGANIC MICROANALYSIS (3) Breakage ticket \$5. *Mr. Fleming*
 476. MICROSCOPIC MICROTÉCHNIQUE (3) Breakage ticket \$5. *Miss Willard*
 477. CHEMICAL PHOTOMICROGRAPHY (3) Breakage ticket \$5. *Miss Willard*
 489. INTRODUCTION TO CHEMICAL RESEARCH (3-5) Breakage ticket \$10.
 489X. INTRODUCTION TO CHEMICAL RESEARCH (2)
 †490. ORGANIC CHEMISTRY (5) Breakage ticket \$5. *Mr. Olewine*
 †491. ORGANIC CHEMISTRY (5) Breakage ticket \$10. *Mr. Olewine*
 †492a. ADVANCED GENERAL CHEMISTRY (3)
 †493S. SELECTED TOPICS IN CHEMISTRY (3)
 †494S. CHEMICAL DEMONSTRATIONS (3)
 500. SEMINAR IN INORGANIC CHEMISTRY (1)
 501. SEMINAR IN PHYSICAL CHEMISTRY (1)
 502. SEMINAR IN ORGANIC CHEMISTRY (1)
 503. SEMINAR IN ANALYTICAL CHEMISTRY (1)

* Graduate credit not allowed for students majoring in chemistry or chemical engineering.

† Candidates for the M.Ed. degree.

‡ Graduate credit only for degrees in education.

516. SYSTEMATIC INORGANIC CHEMISTRY (3) Systematic treatment of inorganic chemistry in terms of modern concepts.
Messrs. Fernelius, Wartik, and Haas
517. CHEMISTRY OF THE LESS FAMILIAR ELEMENTS (3) Continuation of Chem. 516.
Messrs. Fernelius, Wartik, and Haas
518. SPECIAL TOPICS IN INORGANIC CHEMISTRY (3 per semester) Modern developments in specialized fields.
525. ANALYTICAL PROCESSES (3) Separative and determinative processes in analytical chemistry.
Messrs. Hayes, Jordan, and Schempf
526. MODERN INSTRUMENTAL ANALYSIS (3) *Messrs. Hayes, Jordan, and Schempf*
527. SPECIAL TOPICS IN ANALYTICAL CHEMISTRY (2-12)
Messrs. Hayes, Jordan, and Schempf
531. SPECIAL TOPICS IN ORGANIC CHEMISTRY (3-12)
532. ORGANIC NITROGEN COMPOUNDS (3) Chemistry, stereochemistry, and molecular structure of organic compounds containing nitrogen.
Mr. Aston
534. THEORETICAL ORGANIC CHEMISTRY (3) Modern theories of structure; resonance; interpretation of physical properties; theory of rates; equilibrium properties.
Mr. Aston
- 535-536. ORGANIC CHEMISTRY (3 each) Adapted to the needs of those doing research work in organic chemistry.
Mr. Zook
537. ORGANIC CHEMISTRY OF HIGH POLYMERS (3) High polymer theory and practice from the viewpoint of organic chemistry.
Mr. Sommer
538. ORGANIC CHEMISTRY (3) Survey of organic chemistry arranged primarily for graduate students majoring in fields other than organic chemistry.
Messrs. Noll and Oakwood
539. STEREOCHEMISTRY (3) Comprehensive treatment of the principles of stereochemistry as applied to organic compounds.
Mr. Oakwood
541. PHASE RULE (3) The phase rule and its applications.
542. COLLOIDS (3) The physics and chemistry of surfaces and their resulting colloid properties; methods of preparing colloids.
Mr. Smith
543. RHEOLOGY OF COLLOIDS (3) Continuation of Chem. 542. Rheology especially as applied to colloids and similar substances.
Mr. Smith
544. CHEMICAL THERMODYNAMICS (3) Development of thermodynamic theory with special reference to common physical changes and chemical reactions. Prerequisite: Chem. 441 or 562.
Messrs. Aston and Fritz
545. CHEMICAL THERMODYNAMICS AND INTRODUCTORY STATISTICAL MECHANICS (3) Continuation of Chem. 544 including the calculation of thermodynamic properties from molecular and spectroscopic data. Prerequisite: Chem. 544.
Messrs. Aston and Fritz
546. QUANTUM CHEMISTRY (3) Theory of energy levels in atoms and molecules from the standpoint of wave mechanics with special emphasis on the portion of

CHEMISTRY

- the subject applying to common chemical systems. Prerequisite: Chem. 441 or 562. Given alternate years only. *Mr. Aston*
547. STATISTICAL MECHANICS (3) Properties of matter at equilibrium, developed on the basis of energy levels of molecules and statistical mechanical theory. Prerequisite: Chem. 546. Given alternate years only. *Mr. Aston*
548. CATALYSIS (3) Theory of catalysis and its application to industry.
549. PHYSICAL CHEMISTRY OF HIGH POLYMERS (3) Physicochemical principles related to the properties of synthetic and natural polymeric systems. *Mr. Woodward*
- 561-562. CHEMICAL PRINCIPLES (3 each) Mathematical treatment of the classical principles of chemistry; their application to problems. Required of all graduate students. Prerequisites: Chem. 461, Math. 43, Phys. 285. A course in organic chemistry is recommended. *Messrs. Seward, Fritz, Ascah, and Taft*
563. CHEMICAL KINETICS (3) Theory and measurement of the rates of chemical reactions; the mechanism of chemical reactions. *Messrs. Ascah and Taft*
564. CHEMICAL KINETICS (3) Continuation of Chem. 563 but including theory and measurement of photochemical reactions. *Messrs. Ascah and Taft*
- 565-566. ATOMIC AND MOLECULAR STRUCTURE (3 each) Structure of chemical species and correlation of experimentally determined properties by structural theory.
- 567-568. ADVANCED THEORETICAL CHEMISTRY (3 each) Modern and current theories of the properties of chemical substances and their applications to chemical problems; the construction of chemical theory.
581. EXPERIMENTAL METHODS IN PETROLEUM CHEMISTRY (1-12)
582. TOPICS IN PETROLEUM CHEMISTRY (2-6)

CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS

WINONA L. MORGAN, *Head of the Department*
17A Home Economics Building

The M.S. and M.Ed. degrees are offered in the general field of child development and family relationships. The Ph.D. and D.Ed. degrees are offered in either child development or family relationships.

Students may specialize in the guidance and development of children, relationships among various members of the family, problems of all stages of the family cycle, nursery school education, education for home and family living in the schools, parental education, and work with children and families in community agencies.

The entering student should have had at least 6 credits in the physical and biological sciences, 12 in the social sciences (which must include a basic course in sociology and one in psychology), and 6 in child development and family relationships. Students who are otherwise qualified but who lack some of these credits may be admitted and permitted to make up the deficiency credits along with a graduate program.

CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS

CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (CD FR)

405. MARRIAGE AND FAMILY RELATIONSHIPS (3) *Mr. Smith*
429, 429X. CHILD DEVELOPMENT (3) *Miss Avery*
430. OBSERVATION AND EXPERIENCE IN NURSERY SCHOOL (1-4)
440, 440X. STUDY OF LATER CHILDHOOD (3) *Miss Avery*
441. NURSERY SCHOOL ORGANIZATION (3) *Miss Morgan*
445. (Psy. 445). DEVELOPMENT THROUGHOUT ADULTHOOD (3) *Mr. Smith*
481. EDUCATIONAL METHODS WITH PRESCHOOL CHILDREN (3) *Miss Bovie*
482. EDUCATIONAL PROCEDURES IN CHILD DEVELOPMENT AND FAMILY RELATIONS (3) *Miss Morgan*
495S. (Ed. 495S, Hl.Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)
508. PARENTAL EDUCATION (3) Discussion and use of methods, experiences, and programs which can be used effectively to help parents in dealing with problems of parent-child relationships. Prerequisites: C.D.F.R. 429, 430. *Miss Morgan*
515, 515X. THE TEACHING OF CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (3) Methods of selection and presentation of subject matter basic to understanding the development of children, and the attitudes, emotions, and relationships within the family. Not open to students having credit for C.D.F.R. 482. Prerequisite: 6 credits in child development and family relationships. *Miss Morgan*
529. (Psy. 529). SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisites: 6 credits in child development or 6 in educational or child psychology, plus 3 in statistics. *Miss Morgan*
530. PROBLEMS IN CHILD DEVELOPMENT AND FAMILY RELATIONSHIPS (1-6) Problems involving individual research in library, laboratory, or field projects.
536. CHILDREN IN POSTWAR FAMILIES AND COMMUNITIES (3) Postwar family and community situations influencing the development of children; the role of parents and teachers in helping individual children make satisfactory adjustments. Prerequisites: C.D.F.R. 429, 430, or 2 courses in psychology. *Miss Morgan*
545, 545X. THE FAMILY IN ITS COMMUNITY (2-3) Cultural influences on family relationships; how the family orients its members to community living and group participation. Prerequisites: Soc. 1, C.D.F.R. 405; R.Soc. 452 or Psy. 419. *Mr. Smith*
546. SEMINAR IN FAMILY RELATIONSHIPS (1-3) Reading, reports, and discussion of recent research in relationship aspects of family living; particular attention to studies of roles, crises, and adjustments within the family setting. Prerequisite: C.D.F.R. 405 or 6 credits in sociology or psychology. *Mr. Smith*

CIVIL ENGINEERING

BENJAMIN A. WHISLER, *Head of the Department*
208 Main Engineering Building

The department offers graduate work leading to the M.S. and Ph.D. degrees. The entering student should be a graduate in civil engineering from an accredited college of engineering. Students may specialize in structures, hydraulics, transportation

CIVIL ENGINEERING

engineering, surveying and sanitary engineering, or combinations of these, through courses offered both by the Department of Civil Engineering and by other departments of the University.

CIVIL ENGINEERING (C E)

- 400. SEMINAR (1-3)
- 401. CIVIL ENGINEERING PROJECTS (2-12)
- 412. ADVANCED PHOTOGRAMMETRY (3)
- 421. HIGHWAYS AND STREETS (3)
- 422. RAILROADS (3)
- 423. HIGHWAY SAFETY AND TRAFFIC CONTROL (3)
- 431. CIVIL ENGINEERING CONSTRUCTION (3)
- 441. STATICALLY INDETERMINATE STRUCTURES (3)
- 442, 442X. STATICALLY INDETERMINATE STRUCTURES (3)
- 443. PHOTOELASTICITY AND MODEL ANALYSIS (3)
- 444, 444X. SOIL MECHANICS AND FOUNDATIONS (3)
- 446. ADVANCED SOIL MECHANICS (3)
- 451, 451X. ADVANCED HYDROLOGY (3)
- 462, 462X. ADVANCED HYDRAULICS (3)
- 465. ELEMENTS OF HYDRAULIC ENGINEERING (3)
- 466. HYDRAULIC MACHINERY (3)
- 471. MUNICIPAL AND RURAL SANITATION (3)
- 472. TREATMENT PLANTS (4)
- 473. WATER AND SEWAGE ANALYSIS (3)
- 474. SANITARY ENGINEERING PROBLEMS (1-6)
- 481. MUNICIPAL PLANNING AND ZONING (3)

- 500. SEMINAR IN CIVIL ENGINEERING (1-6) Reports on researches and special topics. Course may be continued in subsequent semesters.

- 521. TRANSPORT PLANNING AND DESIGN (2-6) Planning and design of transportation facilities; basic principles and engineering techniques applied to airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

- 522. TRANSPORT OPERATION AND MAINTENANCE (2-6) Engineering problems in operation, maintenance, and administration of airways, highways, pipe lines, railways, waterways. Prerequisite or concurrent: C.E. 51, 421, 422, or 481.

- 540. ADVANCED STRUCTURAL ANALYSIS (2-4) Geometry of flexure, deflections; analysis of continuous beams, rigid frames, arches; influence lines. Prerequisite: C.E. 40.

- 541. ADVANCED STRUCTURAL ANALYSIS (2-4) Truss deflection; trusses with redundant members, continuous trusses, framed arches; influence lines; secondary stresses; wind stresses; space framework; suspension bridges. Prerequisite: C.E. 40.

- 542. APPLIED SOIL MECHANICS (2-5) Soil classification by type of clay minerals and profile development; aerial photographic interpretation of soils and applications to site selection for dams, highways, and airports. Prerequisites: C.E. 412, 444, Geol. 71.

- 543. STRUCTURAL ENGINEERING PROJECTS (3-10) Investigation or design projects in concrete, soil mechanics, photoelasticity, analysis, etc. Prerequisite or concurrent: C.E. 441, 442.

544. **ADVANCED STRUCTURAL DESIGN (2-4)** Plain and reinforced concrete design as applied to buildings, bridges, retaining walls, domes, tanks, and dams; prestressed concrete. Prerequisites: C.E. 42, 442.
545. **ADVANCED STRUCTURAL DESIGN (2-4)** Structural steel design as applied to riveted and welded girders, trusses, rigid frames, wind connections; timber design. Prerequisite: C.E. 41.
550. **ENGINEERING CONSTRUCTION (2-4)** Construction methods applied to foundations, buildings, bridges, and other civil engineering construction work. Prerequisites: C.E. 41, 42.
551. **HYDROLOGIC INVESTIGATIONS (2-8)** Application of hydrologic principles and techniques to a specific project. Prerequisite: C.E. 451.
560. **THEORY OF HYDRAULIC MODELS (3)** Application of dimensional analysis and similitude to models used in the study of problems in hydraulics.
565. **TRANSPORTATION OF SOLIDS BY FLUIDS (2-5)** Fundamentals of the flow of solids in open and closed conduits; e.g., suspended load and bed load in rivers, slurries and pulp stocks in pipes.
566. **FLUID MECHANICS OF HYDRAULIC MACHINERY (3)** Advanced theory and design of hydraulic machinery. Prerequisite: C.E. 466.
568. **THEORETICAL HYDRODYNAMICS (3-6)** Fundamental equations of fluid motion, stream function, velocity potential, flow nets, transformations, motion of viscous fluids, applications.
570. **RURAL SANITATION DESIGN (3)** Requirements and devices essential to rural sanitary problems: water supply, excreta disposal, industrial waste treatment. Not intended for civil or sanitary engineering students. Prerequisites: Chem. 4, Phys. 285.
571. **WATER PURIFICATION AND SOFTENING (3)** Current methods of softening, disinfecting, and conditioning water for municipal and industrial use. Prerequisite: C.E. 70.
572. **SEWAGE TREATMENT (3)** Modern methods of sewage treatment. Prerequisite: C.E. 70.
573. **ADVANCED PROBLEMS IN SANITARY ENGINEERING (3-10)** Continuation of C.E. 474 on a graduate level. Prerequisite: C.E. 474.
575. **ADVANCED INDUSTRIAL WASTE TREATMENT (3)** Techniques of industrial waste treatment; attendant stream pollution and stream self-purification factors. Prerequisite: C.E. 472 or 572.
576. **WATER TREATMENT PLANT DESIGN (1-6)** Design of works for treatment of water for municipal and industrial use. Prerequisite: C.E. 71.
577. **SEWAGE TREATMENT PLANT DESIGN (1-6)** Design of works for treatment of sewage or industrial wastes. Prerequisite: C.E. 71.
578. **INDUSTRIAL HYGIENE (3)** Principles of control of industrial toxics and the protection of the worker and the community.
579. **PUBLIC HEALTH ADMINISTRATION (3)** Operation and duties of health departments at the various levels.

CLINICAL SPEECH

EUGENE T. McDONALD, *Director of the Speech and Hearing Clinic*
28 Sparks Building

The Speech and Hearing Clinic offers graduate training leading to the M.Ed., M.S., D.Ed., and Ph.D. degrees. Students may specialize in either speech correction or audiology.

Admission to study for either master's degree requires 27 semester hours in clinical speech and hearing, education, and psychology courses. These must include at least 9 credits in speech correction and/or audiology. Applicants for the M.Ed. degree must have had student teaching. Applicants for the M.S. degree may count credits in speech science toward the required 27 hours.

SPEECH EDUCATION (SP ED)

- 430. HEARING PROBLEMS AND THE TESTING OF HEARING (3)
- 434. AUDIOMETRY AND HEARING AIDS (3)
- 435. CLINICAL PRACTICE WITH THE HEARING HANDICAPPED (1-6)
 - Unit A. Audiologic Evaluation and the Selection of Hearing Aids* (1-4)
 - Unit B. Auditory Training and Speech Reading* (1-4)
- 436. INTRODUCTION TO SPEECH CORRECTION (3)
- 437. CLINICAL PRACTICE IN SPEECH CORRECTION (1-3)
- 439X. FUNDAMENTALS OF SPEECH EDUCATION (3)
- 439aX. METHODS IN SPEECH EDUCATION (3)
- 440, 440X. SPEECH EDUCATION FOR THE CLASSROOM TEACHER (2-3)
- 441S. CURRENT PROBLEMS IN SPEECH AND HEARING (1-6)
- 442. SPEECH PATHOLOGY (3)
- 443. METHODS IN AUDITORY TRAINING AND SPEECH READING (3)
- 445. THE PUBLIC SCHOOL SPEECH CORRECTION PROGRAM (3)

- 525. SEMINAR IN CLINICAL SPEECH PATHOLOGY (3-9) Prerequisites: Sp.Ed. 436, 442.
 - Unit A. Cleft Palate*
 - Unit B. Cerebral Palsy*
 - Unit C. Aphasia*

- 530. SEMINAR IN AUDIOLOGY (2-4) Review of theories of hearing and review of related physiological and psychological researches. Prerequisite: Sp.Ed. 434.

- 537. ADVANCED CLINICAL PRACTICE IN SPEECH CORRECTION (1-9) Prerequisites: Sp.Ed. 437, 442.
 - Unit A. Diagnostic Procedures* (1-3)
 - Unit B. Treatment Procedures* (1-6)

- 540. ARTICULATION DISABILITIES (3) Speech-sound production disorders in children and adults; methods of examination, diagnosis, and treatment. Prerequisites: Sp.Ed. 437, 442.

- 541. THE VOICE AND ITS DISORDERS (3) Physical, physiological, and psychological bases of voice production; causes, nature, and symptoms of its disorders; current clinical methods in voice improvement. Prerequisites: Sp.Ed. 437, 442.

- 542. STUTTERING AND ALLIED DISORDERS (3) Modern theories of causes of disorders of rhythm; methods of examination, diagnosis, and treatment. Prerequisites: Sp.Ed. 437, 442.

543. DIAGNOSTIC PROCEDURES IN CLINICAL SPEECH (3) Clinical instrumentation; case history taking; examination procedures and materials used in diagnosing speech disabilities; interpretation of findings; report preparation. Prerequisites: Sp.Ed. 437, 442.

CLOTHING AND TEXTILES

RUTH W. AYRES, *Head of the Department*
116A Home Economics Building

A graduate major in clothing and textiles may lead to an M.S., M.Ed., Ph.D., or D.Ed. degree. Work may be taken with major emphasis on the textile side, which stresses the background natural sciences, or on the clothing side, which stresses the background social sciences. Candidates are accepted who have a strong background and a good record in home economics, chemistry, sociology, economics, or psychology.

CLOTHING AND TEXTILES (CL TX)

- 402, 402X. FUNDAMENTAL PRINCIPLES OF TAILORING CONSTRUCTION (3)
 403. CREATIVE PATTERN MAKING (3)
 404. DRAPING (3)
 405, 405X. FASHION MERCHANDISING (3)
 406. FASHION PROMOTION (3)
 407. THE TEXTILE AND CLOTHING INDUSTRY (3)
 408. INTERMEDIATE TEXTILES (3)
 410. CLOTHING FOR THE FAMILY (3)
 411. ADVANCED CLOTHING CONSTRUCTION (3)
 413. TEXTILE TECHNOLOGY (3)
503. ADVANCED PATTERN DEVELOPMENT (3) Analysis of advanced pattern designing principles to give students facility in original designing.
504. ADVANCED DRAPING (3) Analysis of principles and techniques as a basis for creation of original designs; survey of literature in dress design.
- 505, 505X. CLOTHING INSTRUCTIONAL MATERIALS (3) Development of instructional materials and techniques based on needs of diverse groups.
506. THE FASHION WORLD (3)
507. PROBLEMS IN RELATION TO CLOTHING CONSUMPTION (3) Problems connected with manufacture and consumption of clothing; interrelation of textile and clothing trades with other industries.
508. SPECIAL PROBLEMS IN CLOTHING AND TEXTILES (1-6) Individual directed study, investigation, and practice in selected phases of textiles and clothing.
- 509, 509X. SEMINAR IN CLOTHING AND TEXTILES (1-6)
510. RESEARCH METHODS AND EVALUATION IN CLOTHING AND TEXTILES (1-6)
511. CURRENT DEVELOPMENTS IN CLOTHING AND TEXTILES (1-6)

CLOTHING AND TEXTILES

512. HISTORY OF CLOTHING AND CLOTHING CONSTRUCTION (3)
513. ADVANCED TEXTILE TECHNOLOGY (6)

COMPARATIVE LITERATURE

PHILIP A. SHELLEY
Chairman of the Committee on Comparative Literature
229 Sparks Building

Graduate study in comparative literature may lead to the M.A. and Ph.D. degrees. Programs are arranged through a meaningful selection of courses offered by the several departments of languages and literatures, both ancient and modern, as well as of those specifically in the category of comparative literature. More than a minimum knowledge of foreign languages is required.

COMPARATIVE LITERATURE (C LIT)

400. COMPARATIVE METHOD IN LITERARY STUDIES (3)
443. (Ger. 443). LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9) *Mr. Shelley*
480. INTRODUCTION TO FOLKLORE (3) *Mr. Bayard*
500. SEMINAR IN COMPARATIVE LITERATURE (3-6)

DAIRY SCIENCE

DONALD V. JOSEPHSON, *Head of the Department*
105 Dairy Building

The department offers graduate programs leading to the M.S. and Ph.D. degrees with specialization in dairy products manufacture, chemistry of milk and dairy products, dairy cattle nutrition, dairy cattle management, and physiology of reproduction. The minor program is generally taken in agricultural and biological chemistry, bacteriology, zoology, or agricultural economics.

Prerequisite to graduate work is the completion of an undergraduate curriculum in dairy science or a related science area. The undergraduate program must include college algebra and general physics. Students may be admitted with a limited deficiency but are required to make up undergraduate deficiency work without degree credit.

DAIRY SCIENCE (D SC)

418. DAIRY SURVEY (1) *Mr. Josephson*
421. DAIRY MANUFACTURING PROBLEMS (1-6) *Mr. Doan and Staff*
427. MILK SECRETION (3) *Mr. Kesler*
428. DAIRY PRODUCTION PROBLEMS (1-3) *Mr. Kesler and Staff*
430. TECHNICAL CONTROL OF DAIRY PRODUCTS (4) *Mr. Watrous*
431. PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (3) *Mr. Almquist*

501. BUTTER AND CHEESE (1-6) Manufacture and handling of butter and cheese. Prerequisites: D.Sc. 10, 23, Bact. 8, A.B.Ch. 403.
502. CONDENSED MILK AND MILK POWDER (1-6) Condensing and drying of milk. Prerequisites: D.Sc. 10, 26, Bact. 8, A.B.Ch. 403. *Mr. Doan*
503. PUBLIC MILK PROBLEMS (1-6) Handling milk in modern plants. Prerequisites: D.Sc. 11, Bact. 8, A.B.Ch. 403. *Mr. Doan*
504. ICE CREAM MANUFACTURE (1-6) Manufacture of ice cream, ices, and other frozen milk products. Prerequisites: D.Sc. 11, Bact. 8, A.B.Ch. 403.
505. DAIRY PLANT ECONOMICS (1-6) Economic factors involved in creamery operation and management. Prerequisites: D.Sc. 7, 11.
507. DAIRY CATTLE MANAGEMENT (1-6) Management of dairy cattle. Prerequisite: D.Sc. 27. *Mr. Williams and Staff*
508. DAIRY SEMINAR (1-6) Preparation and presentation of a paper on an assigned subject. *Mr. Josephson and Staff*
509. TESTING DAIRY PRODUCTS (1-6) Constituents of dairy products. Prerequisites: D.Sc. 11, Bact. 8, A.B.Ch. 403. *Mr. Doan*
510. DAIRY CATTLE FEEDING (1-6) Application of fundamental research in animal nutrition to the feeding of dairy cattle. Prerequisites: D.Sc. 1, 29. *Mr. Williams*
511. DAIRY CATTLE NUTRITION (1-6) Nutritional requirements of dairy cattle. Prerequisites: A.Ntr. 401, 402. *Mr. Kesler*
512. ADVANCED STUDIES IN MILK SECRETION (1-6) Physiology of milk secretion. Prerequisite: D.Sc. 427.
513. DAIRY CATTLE SELECTION (1-6) Breed history, pedigrees, selection and judging of dairy cattle. Prerequisites: D.Sc. 1, 30.
515. ADVANCED PHYSIOLOGY OF REPRODUCTION IN FARM ANIMALS (1-6) Reproduction of farm animals. *Mr. Almquist*
516. ARTIFICIAL BREEDING OF FARM ANIMALS (1-6) Prerequisite: D.Sc. 431. *Mr. Almquist*
517. DAIRY SCIENCE LITERATURE (1-6) Review and reporting of dairy literature. *Mr. Josephson and Staff*
522. RESEARCH PROCEDURES IN DAIRY TECHNOLOGY (3) Research problems and methods in dairy technology with major emphasis on dairy chemistry. Prerequisite: A.B.Ch. 403. *Mr. Patton*

ECONOMICS

HOWARD A. CUTLER, *Head of the Department*
113 Sparks Building

Graduate work leading to the M.A. and Ph.D. degrees is offered. Opportunities are available for concentration on economic theory, labor, international economics, government economic policy, money, credit, and public finance.

ECONOMICS

To enter graduate work in economics a student should have completed 6 credits in economic principles, 3 credits in statistics or advanced mathematics, and 9 credits in the social sciences.

ECONOMICS (ECON)

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| 400. HISTORY OF ECONOMIC THOUGHT (3) | <i>Mr. Herman</i> |
| 404. ECONOMIC FRAMEWORK OF MODERN SOCIETY (3) | <i>Mr. Cutler</i> |
| 405. INTERMEDIATE ECONOMIC THEORY (3) | <i>Mr. Fouraker</i> |
| 412. ECONOMICS OF COLLECTIVE BARGAINING (3) | <i>Mr. Myers</i> |
| 415. SOCIAL INSURANCE (3) | <i>Mr. Reede</i> |
| 418. ECONOMICS OF WAGES AND EMPLOYMENT (3) | <i>Mr. Newman</i> |
| 419. CASE STUDIES IN LABOR-MANAGEMENT RELATIONS (3) | <i>Mr. Reede</i> |
| 423. PENNSYLVANIA LOCAL AND STATE FINANCE (3) | <i>Mr. Stout</i> |
| 425. THE MONEY MARKET (3) | <i>Mr. McKinley</i> |
| 428. INCOME AND EMPLOYMENT THEORY (3) | <i>Mr. Kautz</i> |
| 430. NATIONAL PLANNING (3) | |
| 431. HOUSING AND COMMUNITY DEVELOPMENT (3) | |
| 433. INTERNATIONAL MONETARY ECONOMICS (3) | <i>Mr. Mason</i> |
| 434. INTERNATIONAL TRADE AND PUBLIC POLICY (3) | <i>Mr. Mares</i> |
| 442. STRUCTURE OF THE ECONOMY AND PUBLIC POLICY (3) | <i>Mr. Herman</i> |
| 450. THE BUSINESS CYCLE (3) | |
| 480. MATHEMATICAL ECONOMICS (3) | <i>Mr. Mendelson</i> |
| 490. MEASUREMENT OF THE ECONOMY (3) | <i>Mr. Saylor</i> |
| 499X. FOREIGN STUDY IN ECONOMICS (2-6) | |
| | |
| 500. ECONOMICS SEMINAR (3-6) | |
| 501. RESEARCH METHODS IN ECONOMICS (3-6) | <i>Mr. Cutler</i> |
| 506. PROBLEMS IN ECONOMICS (3-6) Planned individual projects involving library, laboratory, or field work. | |
| 507. SEMINAR IN INTERNATIONAL ECONOMICS: THEORY AND POLICY (3-6) | |
| 508. SEMINAR IN MONEY, CREDIT, AND PUBLIC FINANCE (3-6) Prerequisite: Econ. 51. | |
| 510. DEMAND ANALYSIS (3) | <i>Mr. Mendelson</i> |
| 511. SEMINAR IN INDUSTRIAL DISPUTES (3) Prerequisites: Econ. 14, 15. | <i>Mr. Myers</i> |
| 512. WAGES (3) | |
| 513. DEVELOPMENT OF ECONOMIC DOCTRINES (3-6) Prerequisite: Econ. 405. | <i>Mr. Martin</i> |
| 515. LABOR SEMINAR (3) | <i>Mr. Reede</i> |
| 522. ADVANCED ECONOMIC THEORY (3-6) Theory of price and income determination. Prerequisite: Econ. 405. | <i>Mr. Mendelson</i> |

EDUCATION

CHARLES M. LONG, *Head of the Department*
109 Burrowes Building

Graduate degree programs in the department are provided for the advanced preparation of competent public school teachers, administrators, supervisors, and special-

ists. Candidates for the M.Ed., M.S., D.Ed., and Ph.D. degrees may major in business education, educational administration, elementary education, guidance, higher education (D.Ed. program only), clinical speech, and secondary education.

In general, admission requirements for the M.Ed. include 27 approved undergraduate credits in education and psychology including practice teaching in an area appropriate to the major, and aptitude for and interest in advanced professional preparation. Applicants are encouraged to have had at least two years of successful teaching experience. The admission requirements for the M.S. and Ph.D. degrees, and the D.Ed. degree in higher education, are slightly different.

Course sequences are also provided in audio-visual instruction, language arts education, history and philosophy of education, special education, educational research, curriculum and supervision, nature education, adult education, and safety education.

While candidates are required to specialize in a field of professional education, they are also encouraged to acquire a general education in the social sciences, the behavioral sciences, and the humanistic foundations.

In addition to these programs sponsored by the Department of Education, other departments offer work in agricultural education, art education, home economics education, industrial education, music education, physical education, and recreation education. Programs in these major fields are described elsewhere in this bulletin.

The M.Ed. degree is, in general, available in those fields outside of education for which a master's degree has been approved, provided such a professional program is appropriate. Thus, for example, the M.Ed. degree may be earned with a major in English or chemistry. These programs require an approved minor in education.

EDUCATION (ED)

- 408. INTRODUCTION TO VOCATIONAL REHABILITATION (3)
- 412. HISTORY OF MODERN EUROPEAN EDUCATION (3)
- 413, 413X. HISTORY OF EDUCATION IN THE UNITED STATES (2-3)
- 415S, 415X. MODERN TENDENCIES IN AMERICAN EDUCATION (1-6)
- 416X. SOCIAL EDUCATION (3)
- 421X. MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)
- 424, 424X. VISUAL AND OTHER SENSORY AIDS FOR TEACHERS (1-3) *Mr. VanderMeer*
- 425S, 425X. THE SCIENTIFIC DIRECTION OF LEARNING ACTIVITIES (2-4)
- 426, 426X. EDUCATION OF EXCEPTIONAL CHILDREN (2-3) *Miss Neuber*
- 427. EDUCATION OF THE MENTALLY RETARDED (2-3) *Miss Neuber*
- 428, 428X. ADULT EDUCATION: ORGANIZATION, TYPES, AND METHODS (1-3) *Miss Cologne*
- Unit A. *History, Philosophy, and General Organization and Administration of Adult Education* (1)
- Unit B. *Types of Adult Education: Parental Education* (1)
- Unit C. *Methods in Adult Education and Leadership of Discussion Groups* (1)
- 429, 429X. EDUCATION OF THE MENTALLY GIFTED CHILD (1-3) *Miss Neuber*
- 430, 430X. VISUAL AND OTHER AIDS IN SAFETY EDUCATION (3)
- 432b, 432bX. THE ELEMENTARY SCHOOL READING PROGRAM (2-3) *Messrs. Murphy and Hunt*
- 432c, 432cX. READING PROBLEMS IN THE SECONDARY SCHOOL (2-3) *Messrs. Murphy and Hunt*
- 432d, 432dX. SPECIAL PROBLEMS IN THE TEACHING OF ELEMENTARY SCHOOL ENGLISH (2-3) *Mr. Murphy*
- 432eX. CHORAL SPEAKING (3) *Mr. Murphy*

EDUCATION

- 432f, 432fX. TEACHING SECONDARY SCHOOL ENGLISH (2-3) Mr. Murphy
 432g, 432gX. READING DISABILITIES (2-3) Mr. Hunt
 432h, 432hX. TECHNIQUES IN REMEDIAL READING (2-6) Mr. Hunt
 433e. ADVANCED THEORY OF KINDERGARTEN (3) Mrs. Graffius
 433f, 433fX. TEACHING CHILDREN'S LITERATURE (2-3) Mr. Murphy
 433h, 433hX. PROBLEMS OF ELEMENTARY SCHOOL ARITHMETIC (2-3) Messrs. Corle and Russell
 433n, 433nX. TEACHING SOCIAL STUDIES IN THE ELEMENTARY GRADES (2-3) Miss Taylor
 433w, 433wX. TEACHING SOCIAL STUDIES IN THE HIGH SCHOOL (2-3) Mr. VanderMeer
 433y, 433yX. TEACHING MATHEMATICS IN THE SECONDARY SCHOOL (3)
 435X. EDUCATION FOR CITIZENSHIP (2-3)
 438, 438X. TEACHING SCIENCE IN SECONDARY SCHOOLS (2-3) Miss Alfke
 438e, 438eX. TEACHING SCIENCE IN THE ELEMENTARY SCHOOL (1-3)
 439, 439X. TEACHING TRAFFIC SAFETY AND AUTOMOBILE OPERATION (3) Messrs. Neyhart and Intorre
 440, 440X. ORGANIZATION AND SUPERVISION IN SAFETY EDUCATION (3)
 441X. PSYCHOLOGY OF ELEMENTARY SCHOOL SUBJECTS (2-3)
 442, 442X. ELEMENTARY EDUCATION (2-3)
 445. PRODUCTION OF VISUAL AND AUDITORY MEDIA (2-9)
 Unit A. Preparation of Educational Still Pictures (2-3)
 Unit B. Scripting and Shooting Educational Motion Pictures (2-3)
 Unit C. Editing and Sound Recording in the Production of Educational Motion Pictures (2-3)
 446, 446X. DIAGNOSIS OF ATTAINMENT (3) Mr. Cobb
 448X. ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3)
 449aS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3) Mr. Porter
 449bS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE ELEMENTARY SCHOOL (3) Mr. Porter
 449cS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3) Mr. Porter
 449dS. TEACHING OF CONSERVATION OF NATURAL RESOURCES IN THE SECONDARY SCHOOL (3) Mr. Porter
 450X. SECONDARY EDUCATION (2-3) Mr. Butler
 451X. SPECIAL PROBLEMS OF THE HIGH SCHOOL TEACHER (2-3)
 453, 453X. GUIDANCE PRINCIPLES AND PRACTICES (3) Mr. Wellington
 454, 454X. EXTRACURRICULAR ACTIVITIES IN THE JUNIOR AND SENIOR HIGH SCHOOL (2-3) Messrs. Moyer and Patrick
 456, 456X. PRINCIPLES AND PROBLEMS IN BUSINESS EDUCATION (1-3) Mr. Gemmell, Miss Veon
 459, 459X. IMPROVEMENT OF INSTRUCTION IN BUSINESS SKILL SUBJECTS (1-3) Mr. Gemmell
 460. CURRICULUMS IN BUSINESS EDUCATION (3) Mr. Gemmell
 461. IMPROVEMENT OF INSTRUCTION IN BASIC BUSINESS SUBJECTS (3) Mr. Gemmell
 462. TEACHING OF SHORTHAND AND TYPEWRITING (3) Mr. Gemmell
 463. TEACHING OF BOOKKEEPING (3) Mr. Gemmell, Miss Veon
 464. METHODS OF TEACHING DISTRIBUTIVE EDUCATION (3)
 466. TEACHING OF OFFICE PRACTICE (3) Miss Veon
 467. TEACHING OF SHORTHAND (2-3) Miss Veon
 468. TEACHING OF TYPEWRITING (2-3) Miss Veon
 470, 470X. EDUCATIONAL MEASUREMENTS (2-3)
 474, 474X. TEACHING AND GROUP GUIDANCE ABOUT OCCUPATIONS (3) Mr. Corle

- 480, 480X. EDUCATIONAL ADMINISTRATION (2-3) *Mr. DeLacy*
 482X. SUPERVISION AND IMPROVEMENT OF INSTRUCTION (2-3)
 485X. CURRICULUM CONSTRUCTION (2-3) *Messrs. McGarey and McNerney*
 487, 487X. PROBLEMS IN VISUAL AND OTHER SENSORY AIDS IN EDUCATION (1-14)
Mr. VanderMeer
Unit A. Organization and Administration of Visual-Sensory Aids Programs (1-3)
Unit B. Motion Pictures in Education (2-3)
Unit C. Radio and Television in Education (3)
Unit D. Still Pictures (1-2)
**Unit E. Advanced Audio-Visual Equipment (3)*
 490. PHILOSOPHIC BASIS OF EDUCATION (3)
 491X. SCHOOL LAW (3)
 493. CHARACTER EDUCATION (2-3) *Mr. Chiappetta*
 494. RELIGIOUS EDUCATION (2-3)
 495S. (C.D.F.R. 495S, Hl.Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)
 497S, 497X. WORKSHOP IN SELECTED STUDIES IN ELEMENTARY AND SECONDARY EDUCATION (1-6)
 498, 498X. PRACTICUM IN THE EDUCATION OF ATYPICAL CHILDREN (1-8)
 499, 499X. ATYPICAL CHILDREN AND EDUCATIONAL ADJUSTMENTS (3) *Miss Neuber*
 501. INTRODUCTION TO THE ADVANCED STUDY OF EDUCATION (1-3) Methods of educational research; criticism of studies and theses in education; initiating research projects; summarizing results of research. Prerequisite: Ed. 470 or Psy. 415.
Mr. Davison
 502. SUPERVISED EXPERIENCE IN STUDENT COUNSELING (3) Practice in the application of guidance principles and methods to cases counseled under supervision; case conferences; seminar in guidance techniques. Prerequisite: Ed. 453.
Mr. Wellington
 503. SUPERVISION OF GUIDANCE WORKERS (3) Practical experience in supervising and evaluating work of counselors. Prerequisite: Ed. 502. *Mr. Wellington*
 504. ORGANIZATION AND ADMINISTRATION OF GUIDANCE PROGRAMS (3) Principles, organization, personnel, functions, integration with school program, evaluation. Prerequisite: Ed. 453. *Mr. Wellington*
 505. OCCUPATIONAL AND EDUCATIONAL INFORMATION (3) Occupational information for guidance purposes, educational information related to vocational choice and preparation. Prerequisite: Ed. 453. *Mr. Wellington*
 506. STUDENT ANALYSIS PROCEDURES FOR COUNSELORS (3) Collection and use of data basic to the counselor's understanding of individuals; the counseling interview and techniques other than testing. *Mr. Wellington*
 507, 507X. GUIDANCE SERVICES IN ELEMENTARY EDUCATION (3) Guidance services to elementary school students; guidance opportunities for elementary teachers and principals.
 509. CONTRIBUTIONS OF PROFESSIONAL PERSONNEL TO VOCATIONAL REHABILITATION (3) Contributions of medical, social, psychological, and other specialists through the team approach; professional ethics, medical problems. Prerequisites: Ed. 408, 453.

* This unit is not approved for extension.

EDUCATION

510. **INTERNSHIP IN PROFESSIONAL EDUCATION (1-9)** Internship to take place in schools or educational situations where not regularly employed under supervision of graduate faculty.
Unit A. Administration and Supervision (1-6)
Unit B. College Teaching (3-6)
Unit C. Public School Research (3-6)
Unit D. Elementary Teaching (3-6)
Unit E. Secondary Teaching (3-6)
Unit F. Art Teaching and Supervision (3-6)
Unit G. Business Education Supervision (3-6)
Unit H. Special Education Supervision (3-6)
Unit I. Audio-Visual Education (3-6)
511. **SUPERVISED PRACTICUM IN REHABILITATION COUNSELING (3)** Application of principles and techniques of rehabilitation counseling to cases involving handicapped individuals. Prerequisites: Ed. 408, 453.
512. **PROFESSIONAL EXPERIENCE IN REHABILITATION COUNSELING (6)** Supervised internship with responsibility for a regular case load. Prerequisite: Ed. 511.
515. **COMPARATIVE EUROPEAN EDUCATION (3)** Educational policies and practices in school systems in western and central European nations. Prerequisite: Psy. 14.
Messrs. Chiappetta and Russell
516. **SOCIAL FOUNDATIONS OF EDUCATION (2-4)** Social institutions and functions and their relationship to public education; an analysis of the functions assignable to formal education. Prerequisites: Ed. 25, Psy. 14.
Mr. McNerney
517. **EVOLUTION OF EDUCATIONAL THOUGHT (2-3)** Rise of formal educational philosophy from Plato to John Dewey; preliminary reference to Chinese, Hindu, Chaldean, Persian, Hebrew, and Egyptian theories.
523. **LABORATORY IN ORGANIZATIONAL ASPECTS OF MATERIALS OF INSTRUCTION (1-3)** Organizing, storing, circulating, and maintaining instructional material in an instructional materials library. Prerequisites: Ed. 424, 585, Conference 1 hour, alternate weeks by appointment.
Mr. VanderMeer
524. **SEMINAR IN CURRICULUM MATERIALS AND THEIR UTILIZATION (3)** Advanced detailed analysis of mass communication media; relationships among these and educational objectives, individual differences in learners, and ideas to be communicated. Prerequisites: Ed. 424, 585, 6 credits in educational psychology.
Mr. VanderMeer
525. **MODERN TENDENCIES IN EDUCATIONAL METHOD (2-3)** Study of science supporting dynamic instruction; principles of teaching as guides; analysis of modern procedures; understanding of learning; substance versus plans. Prerequisite: 12 credits of undergraduate work in education.
Messrs. Butler and Russell
527. **PROBLEMS IN THE EDUCATION OF THE MENTALLY RETARDED (1-4)** Study of existing curriculums, instructional practices, educational programs; experimentation in curriculum building and materials construction. Prerequisites: Ed. 426 or 583, Unit P, and Ed. 427 and teaching experience.
Miss Neuber
529. **PROBLEMS IN THE EDUCATION OF THE MENTALLY GIFTED (1-4)** Analysis of educational needs of mentally gifted; curriculum construction and curricular materials. Prerequisites: teaching experience and Ed. 426 or 583, Unit P, and 429.
Miss Neuber

532. **SUPERVISION OF STUDENT TEACHERS (3)** A course in supervision for master teachers, department heads, and college teachers with supervisory responsibilities in teacher education. Prerequisite: teaching experience and 18 credits in education, including at least 5 in methods. *Mr. Moyer, Miss Taylor*
- 534a. **READING CLINIC PRACTICE: ANALYSIS OF READING DISABILITIES (1-9)** A laboratory course consisting of analysis of extreme reading disabilities and recommended remedial procedures; experience in preparation of case reports. Prerequisite: Ed. 432g or Psy. 550. *Mr. Hunt*
- 534b. **READING CLINIC PRACTICE: REMEDIAL PROCEDURES (1-9)** Practicum in special classes for reading disabilities; corrective and remedial procedures; specific procedures for correction of various types of reading disabilities. Prerequisite: Ed. 432g or 534a. *Mr. Hunt*
535. **SEMINAR ON READING INSTRUCTION (2-12)** Designed to appraise significant researches and to outline procedures and materials for research; reading readiness, word perception, basic reading skills, vocabulary development. Prerequisite: Ed. 432b or 432c. *Mr. Murphy*
536. **READING CLINIC RESEARCH (1-15)** Prerequisites: Ed. 432b; or Ed. 432c, 432g. *Mr. Murphy*
- 537S. (Bot. 537S, Zool. 537S). **WORKSHOP IN THE BIOLOGICAL SCIENCES (3)** Projects designed for teachers of biology in the secondary schools.
540. **PROBLEMS OF ELEMENTARY EDUCATION (2-3)** Problems seminar for experienced educators. Prerequisite: 12 credits in education and psychology, including 6 in elementary education.
541. **SEMINAR IN CONTEMPORARY ISSUES IN ELEMENTARY EDUCATION (1-3)** Conferences and discussions designed to meet the needs of experienced teachers and principals in the field of elementary education. Prerequisite: 6 credits in elementary education and teaching experience.
546. **ELEMENTARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3)**
548. **ORGANIZATION OF THE ELEMENTARY SCHOOL CURRICULUM (2-3)** Principles underlying curriculum construction. Primarily for elementary education majors. Prerequisite: Ed. 31 or teaching experience.
550. **PROBLEMS IN MODERN SECONDARY EDUCATION (1-4)** Historical, psychological, social, and economic factors influencing secondary education; required as basic course of all graduate students in secondary education. Prerequisite: secondary school teaching. *Mr. Butler*
551. **SEMINAR IN CONTEMPORARY ISSUES IN SECONDARY EDUCATION (2-9)**
- Unit A. The Secondary School Curriculum (2-3)* Principles and philosophy of curriculum construction. Each student works out an individual problem in the secondary school curriculum. Prerequisites: 12 credits in education and psychology, and teaching experience. *Mr. McNerney*
- Unit B. Laboratory Studies in Application of Educational Method (2-3)* Analysis and application of outstanding studies in secondary education; integration of results of educational research with public school procedures. Prerequisites: 12 credits in education and psychology, and teaching experience.

EDUCATION

Unit C. Organization and Administration of Secondary Education (2-3) Problems in reorganization of secondary education, with particular reference to philosophy, organization, and teaching problems of the junior high school. Prerequisites: 12 credits in education and psychology and teaching experience. *Mr. Remaley*

556. *THE SECONDARY SCHOOL PRINCIPAL AS SUPERVISOR (2-3)* Improvement of instruction; improvement of teachers in service; evaluation of teaching procedures; methods of supervision; selection and use of textbooks. Prerequisite: three years' teaching experience. *Mr. McGarey*

561. *THE COMMUNITY COLLEGE AND POST-SECONDARY SCHOOL EDUCATION (2-3)* Philosophy, organization, and character of school programs needed to meet educational needs of individuals who desire to continue their education on the post-secondary school level. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience. *Messrs. Patrick and Brown*

562. *THE INSTRUCTIONAL PROGRAM IN COMMUNITY COLLEGES AND POST-SECONDARY EDUCATION (2-3)* Course offerings, curriculums, instructional materials and procedures, guidance, extracurricular activities, student personnel, evaluation of results, and faculty qualifications. Prerequisites: Ed. 480, 550; Psy. 414 or educational experience.

563. *THE PROFESSIONAL EDUCATION OF TEACHERS (3)* Development and present status of teacher education; objectives and standards; selection and guidance of students; personnel problems in relation to staff. Prerequisite: 6 credits in advanced courses in education and a course in educational psychology. *Mr. Patrick*

564. *RECENT TRENDS IN HIGHER EDUCATION (2-3)* Factors affecting current college enrollment, organization, administration, support, and curriculums, with special emphasis on general education, its development, aims, and forms. *Mr. Brown*

565. *THE PRINCIPLES OF COLLEGE TEACHING (2-3)* Principles involved in teaching at the college level; effective use of teaching aids; criteria used in evaluation. *Mr. Brown*

566. *STUDENT PERSONNEL PROGRAMS AT THE COLLEGE LEVEL (2-3)* Student personnel services in higher education; organization of student advisory programs; use of personnel data; co-curricular activities; student welfare. *Mr. Wellington*

567. *GROWTH AND ORGANIZATION OF HIGHER EDUCATION (2-3)* Growth of higher education; influence of church, state, federal government; educational, social, and economic factors that have affected curriculums and organization of institutions. *Mr. Brown*

568. *CURRICULUMS IN HIGHER EDUCATION (2-3)* Various types of curriculums and philosophies underlying them; ways in which curriculums are developed; elective versus required courses; evaluation of achievement. *Mr. Brown*

569. *SEMINAR IN COLLEGIATE EDUCATION (1-6)* Special topics in higher education. Prerequisite: Ed. 567. *Mr. Weaver*

574. *ADVANCED EDUCATIONAL STATISTICS (2-4)* Appropriate measures and devices for experimental research in education including correlation measures, curve fitting, and analysis of variance. Prerequisite: 12 credits of graduate work in education including Ed. 470 or Psy. 415. *Mr. Davison*

575. ADMINISTRATION AND SUPERVISION IN BUSINESS EDUCATION (3) Work of administrators, supervisors, and others responsible for improvement of instruction in business education; use of vocational testing; job analysis. Prerequisite: 6 credits in secondary education. *Mr. Gemmell, Miss Veon*
576. INTRODUCTION TO RESEARCH IN BUSINESS EDUCATION (3) Methods of research in business education; opportunity to compile annotated bibliographies on current problems; analysis and evaluation of significant research. *Mr. Gemmell*
577. EVALUATION OF RESEARCH AND EMPIRICAL LITERATURE IN BUSINESS EDUCATION (3) Application of evaluation methods to current literature in business education; special attention to research studies. Prerequisite: Ed. 576. *Mr. Gemmell*
578. SEMINAR IN BUSINESS EDUCATION (1-6) Intended for graduate students preparing theses or final documents, or for those working on special studies in business education. Prerequisite: Ed. 577. *Mr. Gemmell*
580. SEMINAR IN SCHOOL ADMINISTRATION (1-6) Efficiency in supervision, methods of diagnosis and evaluation of teaching and learning procedure, improving instruction, maintaining teacher morale, stimulating co-operative work. Prerequisites: Ed. 480, 6 credits of Ed. 583.
582. EDUCATIONAL SURVEY TECHNIQUES (2-3) Methods for appraisal of an educational program; planning for expansion, consolidation, or reduction of educational offerings. Prerequisites: Ed. 480, 6 credits of Ed. 583.
- 583, 583X. PROBLEMS IN ADMINISTRATION AND SUPERVISION (2-27) Prerequisite: Ed. 480 or teaching or administrative or supervisory experience.
Unit A. The Educational Plant (2-3)
Unit B. Public Relations for School Administrators (2-3)
Unit C. Public School Finance (2-3)
Unit F. State and National Education Programs (2-3)
Unit I. Administration of Adult Education in the Public Schools (3)
Unit M. Legal Aspects of School Administration (3)
Unit P. The Administration of Public School Education for Atypical Children (2-3)
**Unit Q. Dynamic Factors in School Administration (2-3)*
**Unit R. Public School Business Administration (2-3)*
585. CURRICULUM CONSTRUCTION (2-3) Functions of administrators, supervisors, teachers, pupils, and laymen in curriculum building to meet pupil and community needs. *Mr. McGarey*
586. PRINCIPLES OF SCHOOL SUPERVISION (2-3) Organization of supervision; planning the supervisory program; developing standards of teaching and learning; improvement of learning through tests and teacher rating. Prerequisites: 18 credits in education and 3 years' teaching experience. *Mr. McNerney*
587. THE SECONDARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-4) Problems of schedule making, teachers' meetings, curriculum making and revision, organization of extracurricular and guidance programs. Prerequisite: teaching experience.
589. THE ELEMENTARY SCHOOL PRINCIPAL AS ADMINISTRATOR (2-3) Duties of the elementary school principal in organizing and administering his school. Prerequisite: Ed. 442.

* These two units are not approved for extension.

EDUCATION

590. **ADVANCED PHILOSOPHY OF EDUCATION (2-4)** Analysis of educational policy and practice for philosophic consistency and commitment; philosophical implication in selected educational literature. *Mr. Chiappetta*
591. **EDUCATION IN RUSSIA, ASIA, AND THE MIDDLE EAST (2-3)** Current educational activities in Soviet Russia and other eastern European countries; the Middle East, North Africa, and the Far East. *Mr. Chiappetta*
592. **EDUCATION IN THE LATIN-AMERICAN COUNTRIES (2-3)** Recent educational progress in Central and South America, with special reference to Mexico, Cuba, Puerto Rico, Brazil, Chile, and Argentina.
594. **SEMINAR IN EDUCATION (1-3)** Conferences and discussions designed to meet the need for special study of particular fields in education. Prerequisite: 12 credits of graduate work in education. *Messrs. Long, Davison, and Russell*
- 597S. **WORKSHOP IN CURRENT EDUCATIONAL PROBLEMS (1-6)** For administrators, supervisors, experienced elementary and secondary teachers, guidance workers; administrative, supervisory, and instructional problems involved in an emerging educational program. Prerequisite: 12 credits of graduate work in education.

ELECTRICAL ENGINEERING

ARTHUR H. WAYNICK, *Head of the Department*
105 Electrical Engineering Building

Graduate work leading to the M.S. and Ph.D. degrees is offered. Course offerings and research facilities are available in the following areas: information theory, microwave theory and techniques, networks, computers (including digital, analog, and network analyzer), control, power conversion, servomechanisms, tubes and transistors, dynamical machine analysis, power dispatching, relay protection, and wave propagation.

The entering student must hold the B.S. degree in engineering or science and have satisfactorily completed undergraduate course work in electrical circuits, machinery, and electronics.

ELECTRICAL ENGINEERING LABORATORY (E E L)

440. **ELECTRICAL COMMUNICATIONS LABORATORY I** (1½)
441. **ELECTRICAL COMMUNICATIONS LABORATORY II** (1½)

ELECTRICAL ENGINEERING (E E)

415. **ILLUMINATION** (3)
421a,b,c,d. **ELECTRICAL ENGINEERING PROBLEMS** (2-12)
422. **CREATIVE ELECTRICAL ENGINEERING** (3)
423. **TRANSIENT PHENOMENA** (3)
424. **POWER FREQUENCY ELECTRONICS** (3)
425. **SYMMETRICAL COMPONENTS** (3)
426. **TRANSISTORS** (3)
428, 428X. **SERVOMECHANISMS** (3)
432. **ULTRA-HIGH-FREQUENCY TECHNIQUES** (3)

- 435, 435X. ENGINEERING ANALYSIS (3)
436. DESIGN, CONSTRUCTION, AND TESTING OF VACUUM TUBES (3)
438. FUNDAMENTALS OF ELECTRIC WAVES (3)
439. PULSE TECHNIQUES (3)
- 440, 440X. VACUUM-TUBE CIRCUITS I (3)
- 441, 441X. VACUUM-TUBE CIRCUITS II (3)
- 450, 450X. ELECTRICAL NETWORK THEORY (3)
460. HIGH-VOLTAGE ENGINEERING (3)
461. FUNDAMENTALS OF POWER SYSTEM STABILITY (3)
470. ELECTRONIC ANALOG COMPUTERS (3)
471. LOGICAL DESIGN OF DIGITAL COMPUTERS (3)
520. SEMINAR (1) Required of all graduate students in electrical engineering. Conferences, reading, and presentation of technical papers.
521. ADVANCED ELECTRICAL ENGINEERING PROBLEMS (2-12)
523. TRANSIENTS IN LINEAR SYSTEMS (3) Transient response of linear electric circuits and electromechanical systems including the application of operational methods of analysis to electrical and electromechanical problems. Prerequisite: E.E. 423.
524. ENGINEERING ELECTRONICS (3) Special problems dealing with design and application of electronic devices and systems; emphasis upon individual projects closely related to other phases of the student's graduate program.
525. SYMMETRICAL COMPONENTS (3) Polyphase circuits and machines under unbalanced conditions of operation including effects of rotating machines upon distribution and transmission system performance; characteristics of phase converters and single-phase operation of polyphase systems. Prerequisite: E.E. 425.
528. SERVOMECHANISMS (3) Advanced treatment of transient and steady-state behavior of closed-cycle control systems with special attention to stability and design of stabilizing controllers. Prerequisite: E.E. 428.
532. ULTRA-HIGH-FREQUENCY ENGINEERING (4) Theory of transmission lines, wave guides, resonant cavities, antennae, and wave propagation. Prerequisite: E.E. 432.
535. ENGINEERING ANALYSIS (3) Engineering applications of complex variables, conformal mapping methods and potential plotting. Laplace transform methods and stability criteria. Prerequisite: E.E. 435.
538. ELECTROMAGNETIC ENGINEERING (3) Electrical and magnetic fields, using the Maxwell-Lorentz equations as applied to vector fields and special solutions for antennae, wave guides, and other engineering applications. Prerequisite: E.E. 438.
550. COMMUNICATION NETWORKS (3) Methods of filter design using lattice networks; effects of dissipation on characteristics of filter networks; transient response of networks and design of equalizers. Prerequisite: E.E. 450.
570. ADVANCED ELECTRONIC ANALOG COMPUTERS (3) Theory and design of linear and nonlinear function generators for electronic analog computers; methods of synthesizing physical systems. Prerequisite: E.E. 470.
571. DIGITAL COMPUTATION AND CONTROL (3) Methods of analysis of digital computers; analysis of sampled-data systems for real-time control purposes.

ENGINEERING MECHANICS

JOSEPH MARIN, *Head of the Department*
204 Engineering A

The department offers graduate study programs leading to the M.S. and Ph.D. degrees. Research and graduate study are available in the following fields of engineering mechanics: dynamics and vibrations, theory of elasticity and strength of materials, experimental stress analysis, theory of plasticity and mechanical properties of materials. The department also offers a fluid mechanics option for both the M.S. and the Ph.D. degrees.

In order to be admitted to graduate work in engineering mechanics, the student must have a B.S. degree in engineering or in some field of science. It is also necessary for him to have satisfactorily completed undergraduate courses in statics, dynamics, strength of materials, and materials of engineering.

ENGINEERING MECHANICS (E MCH)

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| 400, 400X. ADVANCED STRENGTH OF MATERIALS (3) | <i>Messrs. Hardenbergh and Hu</i> |
| 401, 401X. ELEMENTS OF VIBRATIONS (3) | <i>Mr. Vierck</i> |
| 402, 402X. APPLIED AND EXPERIMENTAL STRESS ANALYSIS (3) | <i>Messrs. Marin, Hu, and Oppel</i> |
| 403, 403X. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) | <i>Mr. Marin</i> |
| 404, 404X. RESEARCH IN ENGINEERING MECHANICS (1-6) | |
| 406. ENGINEERING APPLICATIONS OF FLUID MECHANICS (3) | <i>Mr. Ranz</i> |
| 407. NUMERICAL METHODS OF ANALYSIS (3) | <i>Mr. Vierck</i> |
| 408. ELASTICITY AND ENGINEERING APPLICATIONS (3) | <i>Mr. Hardenbergh</i> |

500. ADVANCED MECHANICS OF MATERIALS (3-6) Strain energy methods; special problems in bending and torsion; curved bars, beams on elastic foundations; thick-walled cylinders, shrink-fit assemblies, and rotating discs; thin-walled pressure vessels; bending of thin plates; buckling of bars and plates. Prerequisite: E.Mch. 13.
Messrs. Marin and Hardenbergh

504. APPLIED ELASTICITY (3) Analyses of stress and strain in two dimensions; problems in elasticity and elastic stability; emphasis on applications to machine and structural design. Prerequisite: E.Mch. 13.
Mr. Marin

506. EXPERIMENTAL STRESS ANALYSIS (3) Experimental methods of stress determination including photoelasticity, stress coat and electric strain gauge techniques; stress analogies; strain rosettes for combined stress determinations. Prerequisite: E.Mch. 13.
Messrs. Marin, Hu, and Oppel

507. THEORY OF ELASTICITY AND APPLICATIONS (3) Equations of equilibrium and compatibility; stresses and strains in beams, curved members, rotating discs, thick cylinders, torsion and structural members. Prerequisite: E.Mch. 13. *Mr. Arkilic*

508. THEORY OF ELASTIC STABILITY AND APPLICATIONS (3) Buckling of slender and short members; buckling of I-beams; stability of thin-walled constructions; thin-walled cylinders subjected to internal pressures; applications to structural parts including aircraft members. Prerequisites: E.Mch. 12, 13.

509. THEORY OF PLATES AND SHELLS (3) Bending of circular and rectangular plates; buckling of plates; plates on elastic foundations; deformation of shells without

bending; applications to engineering problems. Prerequisite: E.Mch. 13.

Messrs. Davids and Arkilic

514. ENGINEERING MECHANICS SEMINAR (1 per semester) Current literature and special problems in engineering mechanics.

516. MATHEMATICAL THEORY OF ELASTICITY (3) Stress and strain dyadics; conditions for single valued displacement; incompatibility dyadic; generalized Hooke's Law; uniqueness theorem; special topics in elasticity. Prerequisites: Math. 417, 405.

520. ADVANCED DYNAMICS (3) Dynamics of a particle and of rigid bodies; Newtonian equations in moving co-ordinate systems; Lagrange's and Hamilton's equations of motion; special problems in vibrations and dynamics. Prerequisites: E.Mch. 12, Math. 44 or 431.
Messrs. Davids and Sauer

522. THEORY OF VIBRATIONS (3) Mathematical theory of vibrating systems; damping phenomena; forced vibrations; analogy between mechanical and electrical vibrations; transverse and torsional oscillation of shafts; vibration of strings, beams, membranes, and plates. Prerequisites: E.Mch. 13, Math. 44 or 431.

Mr. Vierck

523. RELAXATION METHODS (3) Relaxation methods compared to iteration and other numerical methods of analysis; application to elasticity, plasticity, stability, fluid flow, heat transfer, and related fields. Prerequisites: E.Mch. 13 or 111, Math. 44.

Mr. Vierck

524. MATHEMATICAL METHODS IN ENGINEERING (3-6) Prerequisite: Math. 451 or E.E. 435 or M.E. 452.

Mr. Davids

Unit A (3) Matrix and tensor analysis, finite differences, relaxation, perturbation, and other approximate methods in solution of various engineering problems.

Unit B (3) Energy methods, potentials, application to torsion problems, non-linear problems, analogies and dimensional analysis, Bessel and other special functions, harmonic analysis.

526. NONLINEAR MECHANICS (3) Integral curves, singular points, self-sustained oscillations, stability problems, Hill's and Van der Pol's equation, mechanical and electrical applications. Prerequisite: E.Mch. 522.

528. EXPERIMENTAL METHODS IN VIBRATIONS (3) Investigation of one or more degrees of freedom, free and forced mechanical vibrations, vibration properties of materials, vibration techniques in nondestructive testing. Prerequisite: E.Mch. 401 or 522.

Mr. Brennan

529. ENGINEERING APPLICATIONS OF SONICS (3) Sound and ultrasound in engineering and science; principles, radiation, transducers, devices for sonic processing and testing. Prerequisite: Phys. 443.

530. MECHANICAL PROPERTIES OF MATERIALS AND DESIGN (3) True stress-strain relations in tension; plastic stress-strain equations for combined stresses; theories of failure for static and fatigue stresses; impact loads; creep of metals; applications to structural and machine design. Prerequisite: E.Mch. 14.

Mr. Marin

531a. THEORY OF PLASTICITY AND APPLICATIONS A (3) Yield conditions; theories of plasticity; differential equation methods; analogy methods; applications to bending, torsion, thick-walled cylinders and discs. Prerequisite: E.Mch. 504 or 507.

Mr. Marin

ENGINEERING MECHANICS

- 531b. THEORY OF PLASTICITY AND APPLICATIONS B (3) Variational principles; limit design; slip line theory; shake down principle; anisotropic metals; application to structure design, metal processing, soil mechanics. Prerequisite: E.Mch. 531a. *Mr. Marin*
533. DETERMINATION OF MECHANICAL PROPERTIES (3) Experimental methods for determining hardness, elastic constants, creep behavior, fatigue strength, plastic flow, and dynamic properties of metals. Prerequisite: E.Mch. 14 or 530. *Mr. Hu*
534. PHOTOELASTICITY (3) Analysis of polariscopes; isoclinics, isochromatics, and stress trajectories; two- and three-dimensional photoelastic methods; determination of principal stresses; model preparation. *Mr. Oppel*
540. MECHANICS OF CONTINUA (3) Unified mathematical treatment of elements of fluid mechanics and of elasticity and plasticity of solids. Prerequisite: Math. 44 or 431.

ENGLISH

BRICE HARRIS, *Head of the Department of English Literature*
204 Sparks Building

Graduate work in English leads to the M.A. and Ph.D. degrees. The student may specialize in English literature, American literature, philology, or rhetoric. It is preferred that an entering student present 24 credits in English, but 18 credits in English exclusive of survey and freshman courses will be accepted. If the student does not present 18 credits in English, he must make up the deficiency early in his graduate work.

ENGLISH COMPOSITION (E CMP)

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| 404. PUBLIC OPINION AND WRITTEN PERSUASION (3) | <i>Mr. Graves</i> |
| 408. ENGLISH GRAMMAR (3) | <i>Miss McElwee</i> |
| 418. THE WRITING OF LITERARY CRITICISM (3) | <i>Mr. Bressler</i> |
| 442. CONTEMPORARY PROSE STYLE (3) | <i>Mr. Major</i> |

ENGLISH LITERATURE (E LIT)

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| 400. TEACHERS' COURSE IN LITERATURE (3) | |
| 401. MAIN CURRENTS IN AMERICAN LITERATURE (3) | |
| 423. FORMS AND MOVEMENTS OF BRITISH LITERATURE (3) | <i>Mr. Ridenour</i> |
| 439S. OUR CONTEMPORARIES (3) | |
| 440. MASTERS OF BRITISH LITERATURE (3) | |
| 441. MASTERS OF AMERICAN LITERATURE (3) | |
| 460. LITERARY BIOGRAPHY (3) | |
| 464. SPENSER (3) | <i>Miss Locklin</i> |
| 466. MILTON (3) | <i>Mr. Condee</i> |
| 480. THE DRAMA BEFORE SHAKESPEARE (3) | |
| 481. JACOBAN AND CAROLINE DRAMA (3) | <i>Mr. Harris</i> |
| 484. AMERICAN DRAMA (3) | <i>Mr. Rubin</i> |
| 486. LATER BRITISH AND IRISH DRAMATISTS (3) | |
| 487. MODERN CONTINENTAL DRAMA (3) | |
| 488. THE DRAMA FROM DRYDEN TO SHERIDAN (3) | <i>Mr. Harris</i> |

ENGLISH (ENGL)

501. MATERIALS AND METHODS OF RESEARCH (3) Bibliography of literary history and criticism; methods of editing and annotating texts; form and materials of dissertations. Required of all graduate students with an English major.
Mr. Ridenour
502. CLASSICAL ORIGINS OF ENGLISH PROSE AND POETIC THEORIES (3) Rhetorical and poetic doctrine of ancient and medieval times.
Mr. Reed
507. RESEARCH PROBLEMS IN ENGLISH (1-6) Methods of research in English, problems of bibliography, and method of evaluating sources and materials.
508. BEOWULF (3) Reading of the text and study of the prominent literary problems and relationships.
509. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE PROSE WRITERS (3)
510. NONDRAMATIC WRITERS OF THE ELIZABETHAN PERIOD: THE POETS (3) *Miss Locklin*
514. SHAKESPEARE (3) Special problems in the works of Shakespeare. *Mr. Bowman*
515. THE AGE OF SWIFT (3) Special studies varying from year to year. *Mr. Harris*
516. THE AGE OF JOHNSON (3) The work of Johnson and his circle. *Mr. Mead*
517. BYRON, SHELLEY, AND KEATS (3) *Mr. Ridenour*
518. PRE-ROMANTIC WRITERS (3) Development of Romantic ideas in the 18th century.
Mr. Ridenour
519. WORDSWORTH, COLERIDGE, SOUTHEY, AND SCOTT (3) *Mr. Ridenour*
530. HISTORY OF THE ENGLISH LANGUAGE (3) Germanic background of English, phonological and morphological developments, dialect differentiations, and principles of linguistic change.
Mr. Mead
531. OLD ENGLISH (3) Old English language and literature with lectures on Old English and Germanic philology.
532. MIDDLE ENGLISH (3) Middle English language and literature with lectures on the development of Old English through Middle English to modern times.
Mr. Mead
534. HISTORICAL ENGLISH GRAMMAR (3) Evolution of the grammatical system of English.
Mr. Peck
535. RENAISSANCE AND MODERN RHETORIC (3) The rhetorical and poetic doctrine of Renaissance and modern times.
Mr. Bressler
540. CHAUCER (3) Analysis of Chaucer's poetry in the light of its background, sources, and subsequent influences.
Mr. Mead
542. PROSE STYLE (3) Development of English prose style. *Mr. Major*
543. CAVALIER AND ANGLICAN (3) Poetry and prose of the middle years of the 17th century from the death of Shakespeare to 1660.
544. RESTORATION LITERATURE (3) Selected studies of writers in England between 1650 and 1700.
Mr. Harris

ENGLISH

545. POETS OF THE VICTORIAN PERIOD, EXCLUSIVE OF TENNYSON AND BROWNING (3) *Mr. Long*
546. TENNYSON AND BROWNING (3) *Mr. Long*
547. PROSE WRITERS OF THE VICTORIAN PERIOD (3) *Mr. Long*
550. SELECTED STUDIES IN THE BRITISH NOVEL TO 1840 (3) *Mr. Bowman*
551. SELECTED STUDIES IN THE BRITISH NOVEL FROM 1840 TO THE PRESENT (3) *Mr. Sutherland*
562. THE AMERICAN NOVEL (3) *Mr. Werner*
563. AMERICAN ESSAYS (3) Lectures and reports on a special group of essayists. *Mr. Werner*
565. THE AMERICAN SHORT STORY (3) *Mr. Werner*
566. AMERICAN POETRY (3) *Mr. Werner*
567. ANGLO-AMERICAN FOLK SONG (3) Oral tradition of melodies and texts; types, regions, theories. *Mr. Bayard*

ENTOMOLOGY

BERTIL G. ANDERSON

Head of the Department of Zoology and Entomology
212 Frear Laboratories

The department offers work leading to the M.S. degree with a major in entomology. Students may specialize in apiculture, ecology, economic entomology, morphology, physiology, insect resistances of plants, taxonomy, or toxicology of insecticides.

In order to undertake graduate work in this field, a student is required to have had 24 credits in entomology or zoology and related biological sciences; and he should have had chemistry through organic chemistry. Courses in physics and mathematics are also advantageous. A limited deficiency may be made up, without degree credit, while pursuing graduate work.

ENTOMOLOGY (ENT)

401. MEDICAL AND VETERINARY ENTOMOLOGY (3) *Mr. Frings*
403. SYSTEMATIC ENTOMOLOGY (3) *Mr. Rutschky*
405. INSECT MORPHOLOGY (3) *Mr. Rutschky*
407. INSECT ECOLOGY (3)
413. ENTOMOLOGY SEMINAR (1 per semester) *Mr. Frost*
429. PRINCIPLES OF INSECT CONTROL (3) *Mr. Blackburn*
430. INSECT HISTOLOGY (2) *Mr. Rutschky*
431. ENTOMOLOGICAL PROBLEMS (1-6)
- 445S. THE IDENTIFICATION OF INSECTS (3)
505. ADVANCED MORPHOLOGY OF INSECTS (3) Advanced work in either external or internal morphology of insects. Prerequisites: Ent. 403, 405. *Mr. Rutschky*

506. IMMATURE INSECTS (3) The morphology and taxonomy of the immature stages of insects. Prerequisite: 9 credits in entomology. *Mr. Blackburn*
508. THE BIOLOGICAL CONTROL OF INSECTS (2) Artificial use of bacteria, fungous diseases, and animals in control of injurious insects; methods and equipment for rearing parasites and predators on a large scale. Prerequisites: Ent. 6, 8, 407. *Mr. Frost*
509. ENTOMOLOGICAL TECHNIQUE (2) For advanced students dealing with special methods of collecting, rearing living insects, preparing and preserving immature stages, keeping records, and preparing illustrations for manuscript. Prerequisite: Ent. 6. *Mr. Coon*
514. ADVANCED SYSTEMATIC ENTOMOLOGY (1-15 per semester) Taxonomy of various orders of insects selected to meet the needs of the individual student. Prerequisites: Ent. 403, 405. *Mr. Rutschky*
528. INSECT PHYSIOLOGY (4) Normal functions of the insect body.
531. INSECT TOXICOLOGY (2) General principles of toxicology and survey of the actions of substances toxic to insects.

FOODS AND NUTRITION

MIRIAM E. LOWENBERG, *Head of the Department*
202A Home Economics Building

The master's degree may be taken in foods or in nutrition. The doctorate is offered in the field of nutrition. The M.S. degree in nutrition in public health is offered in a co-operative program with the University of Pittsburgh.

The student may specialize in foods and nutrition to prepare for teaching in high school or for teaching and/or research work in college. She may also prepare for leadership in adult programs. Study at the master's degree level in foods also prepares students for work in commercial food research laboratories. The program in nutrition in public health prepares the student to work in a public health agency. In addition to receiving training in public health, she has the opportunity to further her preparation in foods and nutrition as well as in other areas dealing with families.

The minimum undergraduate preparation for graduate work in this area includes 18 semester hours in the physical and biological sciences (inorganic, organic, and biological chemistry; bacteriology; and physiology), 9 in the social sciences, and 10 in foods and nutrition.

FOODS, NUTRITION, AND HEALTH (F N)

400. SPECIAL PROBLEMS IN FOODS AND NUTRITION (1-3)
420. EXPERIMENTAL COOKERY (1-6) *Miss Olson*
421. ADVANCED FOODS (3) *Miss Batjer*
- 423, 423X. (H.M.F.E. 423). FAMILY FOOD PURCHASING (2)
425. FOOD PRESERVATION (2) *Miss Hester*
- 426S. RECENT DEVELOPMENTS IN FOODS (3)
450. NUTRITION (4) *Miss Padgett*

FOODS AND NUTRITION

451. RECENT DEVELOPMENTS IN NUTRITION (3)
452. ELEMENTS OF DIET IN DISEASE (3) *Miss Pike*
455, 455X. TEACHING NUTRITION TO BOYS AND GIRLS (3)
456. NUTRITION IN THE COMMUNITY (3) *Miss Lowenberg*
491, 491v. TEACHING HOME NURSING (1)
520. READINGS IN FOODS (2) Critical review and reports of literature on selected food topics. *Miss Hester*
521. SEMINAR IN FOODS (1-6) Discussion and reports on current research in the foods field. Prerequisite or concurrent: F.N. 520. *Miss Hester*
522. ADVANCED EXPERIMENTAL FOODS (3) Experimental methods used in measuring the quality of foods; specific problems in food preparation. *Miss Hester*
530. PROBLEMS IN FOODS AND NUTRITION (1-6)
531, 531X. ADVANCES IN FOODS AND NUTRITION (3) Recent findings in the related areas of foods and nutrition.
550. READINGS IN NUTRITION (3) Readings and reports of selected topics in nutrition. Prerequisite: F.N. 450. *Miss Padgett*
551. SEMINAR IN NUTRITION (1-6) Selected topics and recent advances in nutrition.
552. DIET IN DISEASES (3) Physiological and biochemical problems in metabolic diseases and the nutritional aspects of therapy. *Miss Pike*
553. NUTRITION OF CHILDREN (3) Nutritional needs of the normal child during prenatal life, infancy, and childhood. Prerequisites: A.B.Ch. 35, F.N. 450. *Miss Padgett*
555. FIELD WORK IN NUTRITION (2-4) Field problems planned to meet the needs of individual students. Hours and problems to be arranged.
556. THE SURVEY METHOD IN FOODS AND NUTRITION (2) Study of survey technique as a tool in the assay of food adequacy and nutritional status. *Miss Dodds*
557. INTERRELATIONSHIPS OF NUTRIENTS (2) Interrelationships of nutrients in the metabolic processes; their significance as applied to nutrition. *Miss Pike*

FORESTRY

WILLIAM C. BRAMBLE, *in Charge of Forestry Programs*
102 Forestry Building

The School of Forestry offers graduate work leading to the M.S. and M.F. degrees with a major in forestry. In the Department of Forest Management a student may specialize in forest management, silviculture, or wildlife management; in the Department of Wood Utilization he may specialize in wood utilization, wood technology, or forest products.

A B.S. degree in forestry normally provides the minimum preparation for specialization in any of the above areas except wood utilization. A B.S. degree in wood utilization, or a similar program emphasizing mathematics and basic engineering

courses, provides the minimum preparation for specialization in wood utilization and is acceptable for advanced work in wood technology and forest products. Preparation for graduate work in wildlife management may be secured in any program which has emphasized land management and has included work in dendrology, silvics, forest measurement, and forest management.

Students with limited deficiencies may be admitted but must make up deficiencies without degree credit.

FORESTRY (FOR)

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| 421. REGIONAL SILVICULTURE (4) | <i>Mr. Cope</i> |
| 427. FOREST RANGE MANAGEMENT (3) | <i>Mr. Chisman</i> |
| 445. IMPROVEMENTS (3) | <i>Mr. Worley</i> |
| 450. ADVANCED MENSURATION (3) | |
| 455. AERIAL PHOTOGRAMMETRY IN FOREST MANAGEMENT (2) | <i>Mr. Worley</i> |
| 466. FOREST MANAGEMENT AND MANAGEMENT PLANS (4) | |
| 468. SILVICULTURAL RESEARCH (3-6) | <i>Mr. Chisman</i> |
| 469. PROBLEMS IN FOREST MANAGEMENT (3) | |
| 475. PROBLEMS IN FOREST ECONOMICS AND FINANCE (3) | <i>Mr. Humphrey</i> |
| 480. POLICY AND ADMINISTRATION (3) | |
| 491. LOGGING AND LUMBERING (3) | <i>Mr. Schmidt</i> |
| 497. SMALL SAWMILLS (3) | <i>Mr. Schmidt</i> |
| 504. RESEARCH METHODS IN FORESTRY (2-6 per semester) Review of methods employed in conducting forestry research. | |
| 508. FOREST ECOLOGY (2-4) Organization, development, and classification of forest communities. | <i>Mr. Bramble</i> |
| 509. COVERT MANAGEMENT (2) Management of forest associations for maintenance and development of wildlife. Prerequisite: For. 508. | <i>Mr. Bramble</i> |
| 510. FORESTRY SEMINAR (1-2 per semester) Current problems of forest research presented as weekly seminar reports. May be repeated with additional credit for each semester's work. | |
| 550. FOREST MENSURATION (2-8 per semester) Research in some chosen field. Prerequisite: For. 450. | |
| 560. FOREST MANAGEMENT (3-8) Special topics in forest management and research in some chosen field. Prerequisite: For. 466. | |
| 575. APPLICATIONS OF FOREST ECONOMICS AND FINANCE (3 per semester) Survey of situations in forestry where business problems and particular circumstances of production, value, and costs are currently significant. Prerequisite: For. 70. | |
| | <i>Mr. Humphrey</i> |
| 590. THE LUMBER INDUSTRY (2-4) Relation of the lumber industry to national economy and world trade; lumbermen's associations; lumber accounts. | |
| 591. PROBLEMS IN LOGGING AND LUMBERING (2-6) Research in some chosen phase of lumbering. Prerequisite or concurrent: For. 590. | |

WOOD UTILIZATION (W U)

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| 404. MECHANICAL PROPERTIES OF WOOD (3) | <i>Mr. Nearn</i> |
| 405. VENEER AND PLYWOOD (3) | <i>Messrs. Jorgensen and Nearn</i> |

WOOD UTILIZATION

431. PROBLEMS IN FOREST PRODUCTS (3-6) *Messrs. Norton and Nearn*
435. SEASONING AND PRESERVATION (3) *Mr. Nearn*
437. ADVANCED WOOD TECHNOLOGY (3) *Messrs. White and Jorgensen*
462. DEFECTS IN WOOD (3) *Mr. Norton*
492. LUMBER DISTRIBUTION (3) *Mr. Schmidt*
495. MILLING AND COSTS IN THE FOREST PRODUCTS INDUSTRIES (3) *Mr. Schmidt*
502. WOOD FIBERS (3-5) Identification and physical and chemical characteristics of wood fibers used for pulp, either for paper or as a source of cellulose. Pulping quality, fiber measurements. *Mr. White*
510. WOOD UTILIZATION SEMINAR (1-2 per semester)
530. PROBLEMS IN WOOD UTILIZATION (3-6 per semester) Prerequisite: W.U. 431. *Mr. Norton*
531. STRUCTURAL USES OF WOOD AND WOOD PRODUCTS (3-6 per semester) Wood as a construction material; testing techniques for structural timbers and wood assemblies; use of laminated wood, ring connectors, and other types of special construction. Prerequisite: W.U. 404. *Mr. Norton*
532. LAMINATES (3-6 per semester) Advanced and special studies in fabrication and use of plywood, laminated wood, paper-base laminates, and wood-to-metal bonding. Prerequisite: W.U. 405. *Mr. Norton*
535. CONDITIONING TREATMENTS FOR WOOD (3-6 per semester) Advanced study and problems in preservative, seasoning, and other special treatments for wood and wood products. Prerequisite: W.U. 435. *Mr. Norton*

FUEL TECHNOLOGY

PHILIP L. WALKER, JR., *Head of the Department*
212 Mineral Industries Building

The department offers graduate work leading to the M.S. and Ph.D. degrees. The course program includes the chemistry and combustion of solid, liquid, and gaseous fuels. There is opportunity for research in the chemistry of coals and carbons and in the combustion of fuels.

A bachelor's degree with undergraduate training in one of the following fields is necessary for admission: chemistry, chemical engineering, physics, or fuel technology.

FUEL TECHNOLOGY (F T)

400. FUEL TECHNOLOGY RESEARCH AND DESIGN (1-3)
401. FUEL GASES AND GASIFICATION (3) *Mr. Young*
402. CHEMICALS FROM FUELS (2) *Mr. Kinney*
404. FUEL TECHNOLOGY DESIGN (3) *Mr. Spicer*
405. COMBUSTION CALCULATIONS (3) *Mr. Young*
406. GASEOUS COMBUSTION (3) *Mr. Palmer*
407. COMBUSTION ENGINEERING LABORATORY (2) *Mr. Spicer*
408. COMBUSTION TECHNOLOGY (3) *Mr. Spicer*
409, 409X. THERMAL PROCESSING OF FUELS (2) *Mr. Polansky*
410. THERMAL PROCESSING LABORATORY (2) *Mr. Polansky*

502. RESEARCH DATA (3) Designed for the graduate student beginning laboratory research; methods of obtaining and interpreting research data. *Mr. Nielsen*
503. CHEMICAL CONSTITUTION AND SCIENTIFIC CLASSIFICATION OF COAL (3-6) Chemistry of plant constituents in relation to coal and the coalification process; constitution of coal as deduced by chemical methods; scientific classification of coals. Prerequisite: Chem. 31. *Mr. Kinney*
505. PHYSICOCHEMICAL PROPERTIES OF COAL, MINERAL MATTER, AND ASH (3) Physical, physicochemical, and use properties; their significance and applications. Prerequisite: Chem. 461.
506. ADVANCED SOLIDS COMBUSTION (3) Current approaches to heterogeneous reactions in combustion and gasification of coals and carbons. Prerequisite: Chem. 461. *Mr. Walker*
507. ADVANCED THERMAL PROCESSING (3) Pyrolysis, coal carbonization, coke manufacture and uses; action of heat on coals and fuels; technical and economic factors. Prerequisites: Chem. 35, 461, or Mn.Pr. 410. *Mr. Polansky*
508. SYNTHESIS OF LIQUID FUELS (3) Chemical nature of liquid hydrocarbons; preparation of hydrogen and synthesis gas; theoretical and practical aspects of synthetic liquid fuel processes. Prerequisites: Chem. 31, F.T. 402. *Mr. Kinney*
509. TECHNOLOGY OF TARS (3) Formation, constitution, physical and chemical properties of coal, oil-gas and water-gas tar; processing and utilization. Prerequisite: Chem. 31. *Mr. Polansky*
510. FUEL TECHNOLOGY PROBLEM (1-6 per semester) Special problems in fuel technology. Prerequisite: F.T. 503.
511. FUEL TECHNOLOGY SEMINAR (1-6) Selected topics from current fuel technology research examined and discussed. Prerequisite: Chem. 35 or 461. *Mr. Kinney and Staff*
512. ADVANCED GASEOUS COMBUSTION (3) Theories of reaction mechanisms; measurement of gaseous combustion parameters; review of current literature. Prerequisite: F.T. 406. *Mr. Palmer*
- NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in fuel technology studies are listed under Mineral Sciences in Part II of this bulletin.

GENERAL HOME ECONOMICS

DOROTHY HOUGHTON

Assistant Dean of the College of Home Economics
103 Home Economics Building

General home economics is an unusual major not found in most graduate schools. It is planned for teachers in secondary schools or small colleges and others who wish to be proficient in several areas of home economics. Consequently, the student must have a strong home economics background for admission to the major.

The major for the M.S. or M.Ed. degree consists of a minimum of 6 credits in each of three areas of home economics. Three areas of home economics are also the

GENERAL HOME ECONOMICS

basis for the major at the doctoral level (Ph.D. or D.Ed.). However, the minimum credit requirements in each area are established after consultation with a committee which reviews all previous work.

The student chooses a minor field of basic education or one of the applied fields, such as home economics education, secondary education, or higher education.

GENERAL HOME ECONOMICS (G H E)

400, 400v, 400X, 400vX. RECENT FINDINGS IN HOME ECONOMICS (2-3)

516, 516v. METHODS OF RESEARCH IN HOME ECONOMICS (3) Review of problems and techniques of research in home economics. Required of all graduate students in home economics. *Miss Hatcher*

530. SELECTED PROBLEMS IN GENERAL HOME ECONOMICS (1-6)

GEOGRAPHY

E. WILLARD MILLER, *Head of the Department*
202 Mineral Sciences Building

The department offers graduate work leading to the M.S., M.Ed., Ph.D., and D.Ed. degrees. Students may concentrate on cartography, physical geography, human geography, political geography, economic geography, or regional geography.

In order to enter graduate work, a student must qualify under one of two possible options: Option 1 requires that a student have completed as an undergraduate, with satisfactory grades, 18 credits in geography and 20 credits in mathematics and biological or physical sciences, including at least 6 credits in geology. Option 2 requires 18 undergraduate credits in geography plus 20 credits in the social sciences including at least 3 in economics.

GEOGRAPHY (GEOG)

400. REGIONAL GEOGRAPHY OF NORTH AMERICA (3)	<i>Mr. Deasy</i>
401. REGIONAL GEOGRAPHY OF PENNSYLVANIA (3)	<i>Mr. Miller</i>
403. REGIONAL GEOGRAPHY OF SOUTH AMERICA (3)	<i>Mrs. Griess</i>
405. GEOGRAPHY OF POPULATION AND SETTLEMENT (3)	<i>Mr. Rodgers</i>
420. URBAN GEOGRAPHY (3)	<i>Mr. Rodgers</i>
427S. REGIONAL GEOGRAPHY OF THE SOVIET UNION (3)	<i>Mr. Rodgers</i>
433. REGIONAL CLIMATOLOGY (3)	<i>Mr. Wernstedt</i>
435. FIELD METHODS IN GEOGRAPHY (3)	<i>Mr. Miller</i>
442. GEOGRAPHY OF EUROPE (3)	<i>Mr. Miller</i>
443. GEOGRAPHY OF THE ORIENT (3)	<i>Mr. Wernstedt</i>
444. GEOGRAPHY OF AFRICA (3)	<i>Mrs. Griess</i>
452. INTERPRETATION OF AERIAL PHOTOGRAPHS (3)	<i>Mr. Deasy</i>
460. POLITICAL GEOGRAPHY (3)	<i>Mrs. Griess</i>
480. GEOGRAPHY OF WORLD MANUFACTURING (3)	<i>Mr. Miller</i>

503. ADVANCED REGIONAL GEOGRAPHY (3-12) Intensive study at an advanced level of selected regions or sections of the continents. Prerequisite: 12 credits in geography.

504. PHYSICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of physical geography with emphasis on procedures for organizing material for classroom reports and discussions.
505. ECONOMIC GEOGRAPHY SEMINAR (3-12) The literature of some phase of economic geography with emphasis on procedures for organizing material for classroom reports and discussions.
506. CULTURAL AND POLITICAL GEOGRAPHY SEMINAR (3-12) The literature of some phase of cultural and political geography with emphasis on procedures for organizing material for classroom reports and discussions.
507. DEVELOPMENT OF GEOGRAPHIC THOUGHT (1-6) Critical analysis of the growth of geographic thought from antiquity to the present; emphasis on structure of modern geography.
510. PHYSICAL GEOGRAPHY RESEARCH (3-10) Original study in physical geography: a field problem or detailed library investigation with analysis and presentation of data.
511. ECONOMIC GEOGRAPHY RESEARCH (3-10) Original study in economic geography: a field problem or detailed library investigation with analysis and presentation of data.
512. CULTURAL AND POLITICAL GEOGRAPHY RESEARCH (3-10) Original study in cultural and political geography: a field problem or detailed library investigation with analysis and presentation of data.

GEOLOGY

FRANK M. SWARTZ, *Head of the Department*
110 Mineral Sciences Building

The department offers graduate work leading to the M.S. and Ph.D. degrees with opportunity for specialization in stratigraphy, paleontology, paleobotany, palynology, regional and structural geology, geomorphology, coal geology, and metalliferous geology.

Prerequisites for unconditional admission to graduate standing include a bachelor's degree, together with 25 semester hours in an approved combination of chemistry, physics, mathematics, and biological sciences, and at least 18 semester hours in geology and mineralogy.

GEOLOGY (GEOL)

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| 400. GEOLOGY FOR TEACHERS (3) | |
| 420. PALEOBOTANY (3) | Mr. Spackman |
| 424. GEOLOGY OF COAL (2) | Mr. Nickelsen |
| 451. ECONOMIC GEOLOGY (3) | Mr. Burnham |
| 455. PHYSIOGRAPHY OF NORTH AMERICA (3) | Mr. Dort |
| 461. GEOLOGY OF THE UNITED STATES (3) | Mr. Nickelsen |
| 462. PRINCIPLES OF GEOMORPHOLOGY (3-6) | Mr. Dort |
| 464. PALEONTOLOGY (3) | Mr. Swartz |
| 481. GEOLOGY OF OIL AND GAS (3) | Mr. Scholten |
| 482. METALLIC MINERAL DEPOSITS (3) | Mr. Burnham |

GEOLOGY

483. STRUCTURAL GEOLOGY (3) *Mr. Nickelsen*
 484. PALEOZOIC STRATIGRAPHY (3) *Mr. Swartz*
 485. PALEONTOLOGY (2) *Mr. Swartz*
 486. STRATIGRAPHIC METHODS (1) *Mr. Swartz*
 488. EARTH SCIENCES SEMINAR (1)
 489. EARTH SCIENCES REPORT (1)
- *500. GEOLOGY SEMINAR (1-9) Presentation, at weekly departmental meetings, of topics selected from geological literature.
- †501. STRATIGRAPHY (3-12) Principles of stratigraphic classification, lithofacies and biofacies, faunal zonation, correlation, sedimentation, and paleogeography, illustrated by stratigraphy of classical geologic regions: (a) Pre-Cambrian; (b) Paleozoic; (c) Mesozoic; (d) Cenozoic. Prerequisite: Geol. 464. *Mr. Swartz*
- †503. PALEONTOLOGY (3-9) Morphology of animal groups significant for their fossils; nature of species and faunal zones. Seminars may be arranged for studies of special fossil groups, microfossils, paleoecology. *Mr. Swartz*
504. HISTORY OF GEOLOGY (2-3) Development through the ages of the scientific method in earth sciences. *Mr. Krynine*
507. SEMINAR IN GEOMORPHOLOGY (3-6) Classic and current literature in geomorphology.
511. ORE DEPOSITS: PRINCIPLES (3-6) Geological and geochemical processes controlling ore deposition; genetic classification of ore deposits. Prerequisite: Geol. 451. *Mr. Ridge*
512. ORE DEPOSITS: TYPES (1-6) Geologic history and field examination of selected ore bodies; forming media; causes, sequences, and loci of emplacement; wall rock alteration; secondary enrichment. Prerequisite: Geol. 511. *Mr. Ridge*
515. ORE MICROSCOPY (2-3) Theory and use of the ore microscope in identifying ore minerals in polished section, establishing paragenetic sequences, determining manner of deposition. *Mr. Burnham*
520. SEMINAR IN PALEOBOTANY (2-6) Current and classic literature concerning evolution, paleoecology, and geologic history of vascular plants. *Mr. Spackman*
524. COAL PETROLOGY (1-6) Microscopy, source materials, coalification, constitution, classification of peats, lignites, bituminous coal, anthracite. *Mr. Spackman*
530. GEOLOGICAL PROBLEMS (3-6) Study, from the literature, of a selected geological problem. Prerequisite: 10 credits in geology and mineralogy.
545. GLACIAL GEOLOGY (3) Glaciers: their characteristics, causes, deposits, land forms, effects in periglacial regions.
551. GEOTECTONICS (3-6) Tectonic principles and elements: nature and development of geosynclines, island arcs, mountain structures, stable masses, cratons, mobile belts. *Mr. Scholten*

* Credits to be arranged, 1 to 6 per semester.

† Credits to be arranged, 3 to 6 per semester.

555. **ADVANCED STRUCTURE AND PETROFABRICS (1-3)** Macroscopic and microscopic recognition, measurement, and interpretation of small-scale rock structures and mineral orientation patterns in deformed rocks. *Mr. Nickelsen*
571. **PETROLEUM PROVINCES OF THE WORLD (3)** Stratigraphy, structure, geologic history, and oil and gas occurrence in major petroliferous provinces. *Mr. Scholten*
590. **GEOLOGY FIELD TRIP (1 per year)** Field study of regional geologic features with trips in successive years to differing geologic provinces. Required each spring of all graduate students in geology.

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in geological studies are listed under Mineral Sciences in Part II of this bulletin.

GEOPHYSICS AND GEOCHEMISTRY

B. F. HOWELL, JR., *Head of the Department*
220 Mineral Sciences Building

The M.S. and Ph.D. degrees are offered in the field of geophysics (geophysical prospecting, seismology, gravity, well logging, radioactive age determinations, tectonics) and in the field of geochemistry (crystal chemistry, phase equilibria, element distribution and affiliations, isotope geochemistry, geochemical prospecting, cosmochemistry, high temperature and high pressure geochemistry).

For admission to graduate work in geophysics an applicant is generally expected to have had 10 semester hours of geology and mineralogy, 20 of physics and chemistry, and mathematics through differential equations; for geochemistry, 10 semester hours of geology and mineralogy, 24 of chemistry and physics, and mathematics through integral calculus. Students who have taken somewhat less than the indicated minima in these subjects may be admitted but must make up their deficiencies concurrently with their graduate studies.

GEOPHYSICS AND GEOCHEMISTRY (G G)

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| 401. ELECTRICAL PROSPECTING (3) | <i>Mr. Moore</i> |
| 402. SEISMIC PROSPECTING (3) | <i>Mr. Howell</i> |
| 403. GEOPHYSICS FIELD WORK (1-3) | <i>Mr. Howell</i> |
| 404. MINING GEOPHYSICS LABORATORY (1) | |
| 405. INTRODUCTORY GEOPHYSICS (3) | <i>Mr. Howell</i> |
| 406. INTRODUCTORY GEOCHEMISTRY (3) | <i>Mr. Keith</i> |
| 407. WELL LOGGING (2) | <i>Mr. Moore</i> |
| 408. POTENTIAL THEORY APPLIED TO EARTH PROBLEMS (3) | <i>Mr. Moore</i> |
| 409. GEOPHYSICAL PROSPECTING (3) | <i>Mr. Moore</i> |
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| 500. GEOPHYSICAL SEMINAR (1 per semester) | Discussion of geophysical reports and papers; scientific outlook. Prerequisites: G.G. 401, 402. <i>Mr. Howell</i> |
| 501. RESEARCH (1-15 per semester) | Original research in geophysics or geochemistry. |
| 502. SEISMIC INSTRUMENTS (3) | Characteristics and design of seismometers and seismic recorders. Prerequisite: Phys. 285, differential equations. Given alternate years. <i>Mr. Howell</i> |

GEOPHYSICS AND GEOCHEMISTRY

503. SPECIAL STUDIES IN GEOPHYSICS (1-9) Special studies of the theories of geophysical methods. Prerequisite: 6 credits in geophysics.
507. SEISMOLOGY (3) Nature and transmission of seismic waves; cause and occurrence of earthquakes; applications in seismic prospecting. Prerequisites: Math. 44, Phys. 285. Mr. Howell
508. TECTONICS (3) Seminar in the cause and nature of the principal deformations of the earth. Prerequisite: Geol. 483. Mr. Howell
509. GEOCHEMISTRY SEMINAR (1 per semester) Prerequisite: G.G. 406.
510. PROBLEMS IN GEOCHEMISTRY (1-9) Laboratory and library study of special problems. Prerequisite: G.G. 406.
512. PRINCIPLES AND METHODS IN HIGH-TEMPERATURE GEOCHEMISTRY (3) Ion configuration and radii; simple crystal structures; measurement and control of temperature and pressure; methods of phase equilibrium determination. Mr. Roy
513. PHASE EQUILIBRIA IN MINERAL SYSTEMS (3-6) Phase relations and constitution of inorganic crystals and liquids; special emphasis on systems closely related to natural magmas and rock systems. Prerequisite: G.G. 512. Mr. Osborn
514. ELEMENT DISTRIBUTION IN THE EARTH (3) Principles and data from studies of phase equilibria, petrology, and crystal structure as related to distribution of elements in minerals, rocks, and the earth.
515. ELECTRIC WELL-LOGGING (2-3) Prerequisites: Math. 431, Phys. 285. Mr. Moore
516. NUCLEAR GEOPHYSICS (3) Natural radioactivity and its measurement, spectroscopy, age determinations, geothermometry, radioactive prospecting and logging.
- NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in geophysical and geochemical studies are listed under Mineral Sciences in Part II of this bulletin.*

GERMAN

PHILIP A. SHELLEY, *Head of the Department*
229 Sparks Building

Graduate study in German may lead to the M.A., M.Ed., or Ph.D. degree. There is opportunity for major emphasis upon either literature or philology. Minimum qualifications for admission include 18 undergraduate credits in German; provision is made, however, for admission with limited deficiencies.

GERMAN (GER)

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| 400. PROSEMINAR IN BIBLIOGRAPHY AND METHODS OF RESEARCH (2) | Mr. Shelley |
| 401. HISTORY OF THE GERMAN LANGUAGE (3) | Mr. Buffington |
| 421. GERMAN LITERATURE IN THE 18TH CENTURY (3) | Mr. Buffington |
| 422. GERMAN LITERATURE IN THE 19TH CENTURY (3) | Miss Adolf |
| 423. GERMAN LITERATURE OF THE 20TH CENTURY (3) | Mr. Steiner |
| 443. (C.Lit. 443). LITERARY RELATIONS OF GERMANY WITH ENGLAND AND AMERICA (3-9) | Mr. Shelley |

- *1G. ELEMENTARY GERMAN FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.
- *2G. ELEMENTARY GERMAN FOR GRADUATE STUDENTS (3) Continuation of Ger. 1G, with opportunity for reading in special fields.
501. GERMAN LANGUAGE SEMINAR (3-9) Critical study of special problems in the Germanic languages, with emphasis on Gothic and the High German dialects in different eras. Papers.
515. GERMAN LITERATURE SEMINAR (3-9) Special aspects and characteristics of individual writers and various types and periods of literature.
524. INTENSIVE STUDY OF THE LIFE AND WORKS OF GOETHE (3) Various phases of the poet's life and individual works. *Mr. Buffington*
531. SPECIAL STUDIES IN THE GERMAN LYRIC (3) *Mr. Shelley*
532. SPECIAL STUDIES IN THE GERMAN DRAMA (3) *Miss Adolf*
533. SPECIAL STUDIES IN THE GERMAN SHORT STORY (3) *Mr. Steiner*
534. SPECIAL STUDIES IN THE GERMAN NOVEL (3) *Miss Adolf*
551. MIDDLE HIGH GERMAN (3) Extensive reading of texts; characteristics of the various dialects. *Mr. Buffington*
552. OLD HIGH GERMAN (3) Essentials of the grammar, with special treatment of the High German sound shift and of ablaut and umlaut. Reading of works written before 1100 A.D. Papers. *Mr. Buffington*
553. GOTHIC (3) Essentials of the grammar; reading of Ulfilas' Bible translation. Suitable also for advanced students in English. Papers. *Miss Adolf*

HISTORY

JOSEPH G. RAYBACK, *Head of the Department*
116 Sparks Building

The department offers graduate programs leading to the M.A., M.Ed., Ph.D., and D.Ed. degrees. The student may specialize in medieval history, early modern European history, modern European history, colonial American history, 19th century American history, modern American history, or Latin-American history.

The entering student should present evidence of undergraduate course work covering the history of Europe from ancient times to the present and the history of America from its discovery to the present.

HISTORY (HIST)

- 405, 405X. HISTORICAL BACKGROUND OF AMERICAN POLITICAL PARTIES, 1607-1900 (3) *Mr. Rayback*
406. HISTORY OF AMERICAN LABOR (3) *Mr. Rayback*
407. THE DIPLOMATIC HISTORY OF THE UNITED STATES (3) *Mr. DeNovo*

* No graduate credit is given for this course.

HISTORY

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| 416. ANCIENT CIVILIZATION (3) | <i>Mr. Dahmus</i> |
| 418. RENAISSANCE AND REFORMATION (3) | <i>Mr. Green</i> |
| 419, 419X. RECENT EUROPEAN HISTORY (3) | <i>Mr. Forster</i> |
| 421, 421X. RECENT AMERICAN HISTORY (3) | <i>Mr. Murray</i> |
| 423. THE FORMATIVE PERIOD OF AMERICAN HISTORY (3) | <i>Messrs. Klein and Colbourn</i> |
| 429. INTELLECTUAL HISTORY OF THE MIDDLE AGES (2-3) | <i>Mr. Dahmus</i> |
| 437. THE MIDDLE AGES FROM CONSTANTINE TO THE CRUSADES (3) | <i>Mr. Dahmus</i> |
| 438. THE MIDDLE AGES FROM THE CRUSADES TO THE RENAISSANCE (3) | <i>Mr. Dahmus</i> |
| 440. HISTORY OF ENGLAND AND GREAT BRITAIN SINCE 1485 (3) | <i>Mr. Forster</i> |
| 441. RECENT HISTORY OF GREAT BRITAIN (3) | <i>Mr. Forster</i> |
| 443. HISTORY OF MODERN RUSSIA (3) | <i>Mr. Thaden</i> |
| 444. EASTERN EUROPE IN MODERN TIMES (3) | <i>Mr. Thaden</i> |
| 447. ECONOMIC DEVELOPMENT OF MODERN EUROPE SINCE 1750 (3) | <i>Mr. Pundt</i> |
| 448. SOCIAL AND CULTURAL HISTORY OF MODERN EUROPE (3) | <i>Mr. Pundt</i> |
| 450. ECONOMIC DEVELOPMENT OF COLONIAL AMERICA, 1607-1783 (3) | <i>Mr. Freiberg</i> |
| 451. SOCIAL AND CULTURAL HISTORY OF COLONIAL AMERICA, 1607-1783 (3) | <i>Mr. Freiberg</i> |
| 452. SOCIAL AND CULTURAL HISTORY OF THE UNITED STATES SINCE 1783 (3) | <i>Mr. Brown</i> |
| 453. AMERICAN POLITICAL BIOGRAPHY (3) | <i>Messrs. Klein and Murray</i> |
| 454. THE ECONOMIC DEVELOPMENT OF THE UNITED STATES IN THE 19TH CENTURY (3) | <i>Mr. McNall</i> |
| 460. LATIN AMERICA AND THE UNITED STATES (3) | <i>Mr. Gray</i> |
| 461. SOCIAL AND CULTURAL HISTORY OF LATIN AMERICA (3) | <i>Mr. Gray</i> |
| 499X. FOREIGN STUDY IN HISTORY (2-6) | |
| 501. EUROPEAN HISTORIOGRAPHY (3) | <i>Mr. Pundt</i> |
| 502. AMERICAN HISTORIOGRAPHY (3) | <i>Mr. Klein</i> |
| 504. MEDIEVAL CIVILIZATION (3-9) | <i>Mr. Dahmus</i> |
| 505. THE AGE OF THE REFORMATION (3-6) | <i>Mr. Green</i> |
| 508. STUDIES IN EUROPEAN HISTORY, 1600-1789 (3-6) | <i>Mr. Pundt</i> |
| 509. EUROPE SINCE 1789 (3-6) Prerequisites: Hist. 18, 19. | <i>Messrs. Pundt and Forster</i> |
| 512. STUDIES IN PENNSYLVANIA HISTORY (3-6) | <i>Mr. Klein</i> |
| 520. COLONIAL AND REVOLUTIONARY AMERICA (3-6) Prerequisites: Hist. 20, 21. | <i>Mr. Colbourn</i> |
| 533. THE UNITED STATES, 1783-1860 (3-6) | <i>Mr. Klein</i> |
| 534. THE UNITED STATES, 1860-1900 (3-6) Prerequisites: Hist. 20, 21. | <i>Mr. Brown</i> |
| 536. THE UNITED STATES IN THE 20TH CENTURY (3-6) | <i>Mr. Murray</i> |
| 538. DIPLOMATIC HISTORY OF THE UNITED STATES (3) | <i>Messrs. Gray and DeNovo</i> |
| 540. STUDIES IN BRITISH HISTORY (3-6) | <i>Mr. Forster</i> |
| 550. PROBLEMS IN HISTORY (3-6) | |
| 562. SEMINAR IN LATIN-AMERICAN HISTORY (3-6) Prerequisites: Hist. 22, 23. | <i>Mr. Gray</i> |
| 563. STUDIES IN THE HISTORY OF THE CARIBBEAN AREA (3) Prerequisites: Hist. 22, 23. | <i>Mr. Gray</i> |

HOME ART

CHRISTINE F. SALMON, *Chairman of the Division*
219 Home Economics Building

No advanced degree is offered in this field, but a candidate with a major in another field may choose a minor in home art upon approval by his major department.

HOME ART (H ART)

- 400. SPECIAL PROBLEMS IN HOME FURNISHINGS (3)
- 433, 433X. ADVANCED HOME CRAFTS (2-12)
- 434. THE ART AND THE CRAFTS IN THE HOMEMAKING PROGRAM (3-6)
- 440, 440X. HOME FURNISHING PROBLEMS (3)
- 443. HOME ARTS IN THE ADULT PROGRAM (3)
- 444, 444X. HOME FURNISHING TEACHING PROBLEMS (3)
- 447, 447X. HOME FURNISHINGS FOR THE FAMILY (3)

- 515. BACKGROUNDS OF THE HOME ARTS (3) Evaluation of useful objects in respect to their form, function, and time; selections for exhibition. Prerequisites: H.Art 216 or Art 15 or A.Ed. 6, and A.A.H. 1 or H.Art 240.

- 530. PROBLEMS IN HOME ART (1-6) Individual investigation, analysis, and presentation. Prerequisite: 6 credits in home art, art education, or art.

- 541. ART IN THE ENVIRONMENT (3) Approach based upon human needs with consideration of materials in the light of their use in home living. Prerequisite: Art 14 or A.Ed. 5 or H.Art 440.

HOME ECONOMICS EDUCATION

JEAN D. AMBERSON, *Head of the Department*
119C Home Economics Building

The department offers graduate work leading to the M.S., M.Ed., Ph.D., and D.Ed. degrees. Research and graduate courses may be chosen to give emphasis to special areas of interest in home economics education, such as curriculum development; evaluation; teaching at the elementary, secondary, adult, or higher education levels; supervision; administration in colleges; or research.

The student wishing to study for a graduate degree in this field should present 51 semester hours of undergraduate work in the following areas: home economics education, education and/or psychology, aspects of home economics; the physical and biological sciences; and the social sciences.

HOME ECONOMICS EDUCATION (HE ED)

- 406, 406v, 406X, 406vX. TEACHING AIDS IN FAMILY LIFE EDUCATION (1-4)
- 427, 427v, 427X, 427vX. FAMILY LIFE EDUCATION (3)

HOME ECONOMICS EDUCATION

443, 443v, 443X, 443vX. ADULT HOMEMAKING EDUCATION (3)

463, 463v. SENIOR SEMINAR (1)

*466, 466v. STUDENT TEACHING (9)

478, 478v, 478X, 478vX. APPRAISING STUDENT PROGRESS IN EDUCATION FOR FAMILY LIVING (3)

479, 479v, 479X, 479vX. READINGS IN HOME ECONOMICS EDUCATION (1-4)

502, 502v. HOME ECONOMICS INSTRUCTION AT THE COLLEGE LEVEL (3) Teaching techniques suitable for college instruction in home economics; for prospective home economics college teachers not majoring in home economics education.

503, 503v. PROBLEMS IN HOME ECONOMICS TEACHER EDUCATION (3) Organization of college programs of teacher education; use of resources; records; field services; recruitment and selection of personnel. Prerequisite: at least two years of experience in teaching home economics.

504, 504v. CURRENT DEVELOPMENTS IN EDUCATION IN RELATION TO HOME ECONOMICS (3) Opportunity for home economists to study newer developments in education. Prerequisite: one year of teaching experience in home economics. *Miss Amberson*

505, 505v, 505X, 505vX. PRACTICUM IN TEACHING HOME ECONOMICS IN THE SECONDARY SCHOOL (3-6) Projects in home economics education which may be carried out in the school in which the teacher is regularly employed. *Miss Hillier*

509, 509v, 509X, 509vX. CURRICULUM WORKSHOP IN FAMILY LIFE EDUCATION (3) Laboratory course in problems of curriculum building; individual problems in this field; frequent individual and group conferences. Prerequisite: one year's experience in teaching home economics. *Miss Amberson, Hatcher, or Hillier*

510, 510v, 510X, 510vX. THE SUPERVISION OF HOME ECONOMICS TEACHING (2-6) For teachers of home economics desiring to qualify as city, county, or student teacher supervisors. Prerequisite: graduation from a four-year teacher education curriculum and two years' teaching experience in home economics. *Miss Amberson or Miss Hillier*

518, 518v, 518X, 518vX. EVALUATION IN FAMILY LIFE EDUCATION (3) Methods of evaluating progress toward goals in home economics education and use of findings in program planning and revision. *Miss Amberson, Hatcher, or Hillier*

521, 521v, 521X, 521vX. HOME ECONOMICS EDUCATION SEMINAR (2-3) Selected topics and recent developments in education for family living. Conferences and guidance relative to individual research problems. *Miss Amberson or Miss Hatcher*

526, 526v, 526X, 526vX. THE COMMUNITY PROGRAM IN FAMILY LIFE EDUCATION (2-3) Ways of discovering community needs and resources; methods of developing the community program in family living; leadership education for the lay member of the community.

530, 530v. PROBLEMS IN HOME ECONOMICS EDUCATION (1-6 per semester) Individual investigation of problems related to the teaching, supervision, or administration of home economics education.

* A grade point average of 2.2 in all previous work is prerequisite to each course in student teaching.

HOME MANAGEMENT AND FAMILY ECONOMICS

DELPHA E. WIESENDANGER

Head of the Department of Home Management, Housing, and Home Art
103C Home Economics Building

The M.Ed., M.S., D.Ed., and Ph.D. degrees are offered with a major in home management and family economics. Family management practices, their effects upon members of the family unit, and the interaction of such practices with the local and national economy are studied in relation to principles of economics, philosophy, psychology, sociology, and political science.

Those interested in emphasizing a study of home management, family economics, family housing, and home equipment may do so through this major. There are no specific course requirements for admission.

HOUSING AND HOME EQUIPMENT (HS EQ)

413, 413X. HOME EQUIPMENT (3)

470, 470X. HOUSING THE FAMILY (2-3)

HOME MANAGEMENT AND FAMILY ECONOMICS (HM FE)

415, 415X. HOUSEHOLD BUYING PRACTICES (3)

419, 419X. MANAGING FAMILY FINANCIAL RESOURCES (3)

Mrs. Honey

423, 423X. (F.N. 423). FAMILY FOOD PURCHASING (2)

424, 424X. ECONOMIC CONDITIONS IN RELATION TO THE FAMILY (3)

Miss Britton

439, 439X. HOME MANAGEMENT (2)

Mrs. Henderson, Miss Starr, and Mrs. Nolan

442. RESIDENT EXPERIENCE IN HOME MANAGEMENT (3) Room and board will be charged at regular rates.

Miss Starr

445. HOME MANAGEMENT EXPERIENCE (3)

Miss Starr

477. FAMILY MANAGEMENT (3)

515, 515X. CONSUMER PROBLEMS (2-3) Methods of securing, evaluating, and presenting data concerning household commodities. For home economics teachers in high schools, colleges, and adult classes. Prerequisites: F.N. 220, H.M.F.E. 442.

524. ECONOMIC PROBLEMS OF THE HOUSEHOLD (3) Economic problems of the present-day family; special emphasis on factors in household production, use of money income, and standards of living. Prerequisites: H.M.F.E. 439, Econ. 14.

Miss Britton

528. HOME MANAGEMENT SUPERVISION (2-3) Evaluation of objectives and techniques in organization, supervision, and teaching of the home management house experience. Prerequisite: H.M.F.E. 439.

543. HOME MANAGEMENT IN RELATION TO FAMILY LIVING (3) Includes work with families in solution of their management problems. Prerequisites: F.N. 220, H.M.F.E. 439.

Miss Wiesendanger and Mrs. Nolan

544. PROBLEMS IN HOME MANAGEMENT AND FAMILY ECONOMICS (1-6) Investigation of selected problems in home management and family economics. Prerequisite: 6 credits of home management or family economics courses in home economics.

550. SEMINAR IN HOME MANAGEMENT AND FAMILY ECONOMICS (1-6) Discussion and reports on developments in home management and family economics.

HORTICULTURE

RUSSELL E. LARSON, *Head of the Department*
102 Tyson Hall

The department offers major work for the M.S. and Ph.D. degrees with specialization in propagation, production, processing, breeding, nutrition, and other physiological studies of horticultural crop species. Students may also specialize in the field of landscape design.

The prerequisite to major graduate study in horticulture is the completion of an undergraduate curriculum substantially equivalent to one of the horticulture options at this University.

HORTICULTURE (HORT)

- | | |
|---|--------------------|
| 412. STORAGE OF HORTICULTURAL CROPS (3) | <i>Mr. Ritter</i> |
| 418. SUBTROPICAL AND TROPICAL FRUITS (3) | |
| 420. ADVANCED COMMERCIAL VEGETABLE PRODUCTION (3) | <i>Mr. Odland</i> |
| 424. ADVANCED OLERICULTURE (3-6) | <i>Mr. Odland</i> |
| 425. ADVANCED FRUIT AND VEGETABLE PROCESSING I (3) | <i>Mr. Thomas</i> |
| 426. ADVANCED FRUIT AND VEGETABLE PROCESSING II (3) | <i>Mr. Thomas</i> |
| 427. ADVANCED FLORICULTURE (3) | <i>Mr. Boodley</i> |
| 428. ADVANCED FLORICULTURE (3) | <i>Mr. Boodley</i> |
| 434. RECREATION AREAS AND FACILITIES (4) | <i>Mr. Wilson</i> |
| 444. ADVANCED PLANT BREEDING (3-6) | <i>Mr. Walker</i> |
| 446. ADVANCED POMOLOGY (3) | |
| 447. PROBLEMS IN POMOLOGY (1-6) | |
| 453. NURSERY PRINCIPLES AND PRACTICE (3) | <i>Mr. Meahl</i> |
| 454. LANDSCAPE PROBLEMS (3-6) | <i>Mr. Bracken</i> |
| 455. LANDSCAPE PROBLEMS (3-6) | <i>Mr. Bracken</i> |
| 456. PROBLEMS IN NURSERY PRACTICE (3) | <i>Mr. Meahl</i> |
| 460. LANDSCAPE HORTICULTURE PROJECTS (3-6) | <i>Mr. Bracken</i> |
| 461. PARKS AND PARK ADMINISTRATION (3-6) | <i>Mr. Wilson</i> |
| 462. INSTITUTIONAL GROUNDS AND THEIR ADMINISTRATION (3-6) | <i>Mr. Wilson</i> |
| 463. LANDSCAPE HORTICULTURE PROJECTS (1-6) | <i>Mr. Bracken</i> |
| 500. ECOLOGY OF FRUIT PLANTS (3) Factors limiting the distribution and intensity of culture of fruit species and varieties and effect of environmental factors on cultural practices. | |
| 501. EXPERIMENTAL PROBLEMS IN POMOLOGY (2-12) Investigation of problems involving review of literature, field and laboratory research. | |
| 503. EXPERIMENTAL PLANT BREEDING (2-12) Problems based mainly on research work of the department, with review of experimental methods and literature. Prerequisite: Hort. 444. | |
| | <i>Mr. Larson</i> |
| 504. EXPERIMENTAL PROBLEMS IN OLERICULTURE (2-9) Investigation of problems involving review of literature, field and laboratory research. Prerequisite: Hort. 420 or 424. | |
| | <i>Mr. Odland</i> |
| 505. PROBLEMS IN VEGETABLE PRODUCTION (2-6) Methods used in the more valuable contributions to vegetable production. Prerequisite: Hort. 420 or 424. | |
| | <i>Mr. Odland</i> |

HORTICULTURE

506. NUTRITION OF HORTICULTURAL CROPS (2-4) Principles, applications, and interpretations of diagnostic methods for determining fertilizer requirements of horticultural crops. *Mr. Smith*
512. PRINCIPLES OF FRUIT AND VEGETABLE STORAGE (2-4) Principles involved in the maturation, storage, and senescence of fruits and vegetables, and their application. *Mr. Ritter*
513. EXPERIMENTAL PROBLEMS IN ORNAMENTAL HORTICULTURE (2-12) Review of research in ornamental horticulture, with original investigations. *Mr. Meahl*
514. PROPAGATION OF ORNAMENTAL AND FRUIT PLANTS (3) Factors affecting the asexual and sexual propagation of fruit and ornamental plants. *Mr. Meahl*
517. HORTICULTURE SEMINAR (1 per semester) Review of current research publications in horticulture. Each student presents one or more reviews of assigned topics.
518. ADVANCED PROBLEMS IN LANDSCAPE DESIGN (2-12) Selected problems to be assigned for original investigation in the creation, conservation, or management of planted areas. Prerequisite: Hort. 455. *Mr. Bracken*
519. SEMINAR ON THE GENETICS OF HORTICULTURAL CROPS (1 per semester) Review of current research publications on the genetics of horticultural crops. Each student presents one or more reviews of literature on assigned topics.
520. SEMINAR ON THE BREEDING OF HORTICULTURAL CROPS (1 per semester) Each student presents one or more reviews of literature on assigned topics.
521. TECHNICAL PRACTICES IN LANDSCAPE CONTRACTING (2-12) Commercial and technical operations in landscape contracting and maintenance services. Prerequisites: Hort. 460, 461. *Mr. Bracken*
523. PROPAGATION AND IMPROVEMENT OF VEGETABLE AND FLOWER CROPS (3) Methods and special techniques in breeding of flowers and vegetables; maintenance of seed stocks and seed production. Prerequisite: Hort. 444. *Mr. Odland*
524. EXPERIMENTAL PROCEDURES IN HORTICULTURAL RESEARCH (3) *Mr. Larson*
525. HORTICULTURAL RESEARCH TECHNIQUES (3) Practice in and comparison of methods and apparatus used in horticultural research.
526. EXPERIMENTAL PROBLEMS IN FLORICULTURE (2-12) Greenhouse research and review of literature. Prerequisite or concurrent: Hort. 427, 428. *Mr. Mastalerz*
527. EXPERIMENTAL PROBLEMS IN NUTRITION OF HORTICULTURAL CROPS (2-12) Review of current research; problems for independent investigation. *Mr. Smith*
528. PROBLEMS IN FRUIT AND VEGETABLE PROCESSING (2-12) *Mr. Thomas*

INDUSTRIAL EDUCATION

S. LEWIS LAND, *Head of the Department*
301 Burrowes Building

The department offers graduate work leading to the M.Ed., M.S., D.Ed., and Ph.D. degrees with majors in industrial arts education and vocational industrial education.

INDUSTRIAL EDUCATION

Emphasis may be placed on improved teaching, supervision and administration, or preparation for teacher education.

The minimum undergraduate preparation includes graduation from an approved curriculum in the major area.

INDUSTRIAL ARTS (I ART)

400, 400X. SHOP MANAGEMENT AND LAYOUT (2-3)

407, 407X. INDUSTRIAL ARTS EDUCATION (2-3)

421, 421X. CURRICULUM MATERIALS IN INDUSTRIAL ARTS (2-3)

470, 470X. PROBLEMS IN SENIOR HIGH SCHOOL INDUSTRIAL ARTS (2-3)

574. HISTORY AND PHILOSOPHY OF INDUSTRIAL ARTS (2-3) Historical developments and concurrent educational philosophies of industrial arts in American education. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

575. PROBLEMS IN INDUSTRIAL ARTS EDUCATION (2-3) Subject matter, projects, methods of manual and informational teaching, aids and devices, selection of text and reference materials, personnel organization, shop management, problem pupils. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

576. SUPERVISION AND ADMINISTRATION OF INDUSTRIAL ARTS EDUCATION (2-3) How to organize, supervise, and administer functioning programs of industrial arts; duties of a supervisor and director of industrial arts. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

577. TESTING IN INDUSTRIAL ARTS (2-3) Construction of informal manipulative and written tests; use of standardized mechanical aptitude and achievement tests; construction and use of rating scales; scoring and grading; interpretation of test results. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

578. RESEARCH IN INDUSTRIAL ARTS (2-3) Research techniques in industrial arts education. Prerequisite: 6 credits in professional courses in industrial arts.

580. SEMINAR IN INDUSTRIAL ARTS (2-9) Directed intensive study, investigation, or research in selected phases of the program; reports and constructive criticism. Prerequisites: 6 credits in professional courses in industrial arts and teaching experience.

INDUSTRIAL EDUCATION (I ED)

401v, 401vX. HISTORY OF INDUSTRIAL EDUCATION (2-3)

402v, 402vX. SUPERVISION OF VOCATIONAL EDUCATION (2-3)

403v, 403vX. SUPERVISED FIELD WORK (1-6)

405v, 405vX. CONFERENCE LEADER TRAINING (2-3)

408v, 408vX. OCCUPATIONS (2-3)

409v, 409vX. TESTS AND MEASUREMENTS (2-3)

412v, 412vX. SPECIAL PROBLEMS IN VOCATIONAL EDUCATION (2-4)

414v, 414vX. VOCATIONAL EDUCATIONAL GUIDANCE (2-3)

415vS, 415vX. PROBLEMS IN CO-ORDINATING VOCATIONAL EDUCATION (2-3)

418v, 418vX. PROBLEMS IN AUDIO-VISUAL AIDS IN INDUSTRIAL EDUCATION (2-3)

- 420v, 420vX. OCCUPATIONAL HYGIENE (2-3)
- 425v, 425vX. WORKSHOP IN INDUSTRIAL EDUCATION (1-6)
- 427v, 427vX. ADVANCED COURSE OF STUDY BUILDING (2-3)
- 446vS, 446vX. IMPROVEMENT OF INSTRUCTION IN VOCATIONAL EDUCATION (2-4)
- 450v, 450vX. SHOP LAYOUT AND MANAGEMENT (2-3)
- 458v. EMERGING PROBLEMS IN VOCATIONAL EDUCATION (1-7)
- Unit A. *Federal and State Laws Relating to Vocational Education* (1)
- Unit B. *Framework of Federal, State, and Local Administrative Agencies* (1)
- Unit C. *Federal, State, and Local Policies and Plans for Vocational Education* (1)
- Unit D. *Local Administration of Vocational Education* (1)
- Unit E. *Labor Laws and Labor Relations Affecting Education* (1)
- Unit F. *Vocational Training for War and Postwar Eras* (1)
- Unit G. *Problems in Vocational Rehabilitation of the Physically Handicapped* (1)
- 460S. PROBLEMS IN VOCATIONAL REHABILITATION OF THE HANDICAPPED (1-6)
- Unit A. *The Counseling Interview in Vocational Rehabilitation* (1-3)
- Unit B. *Occupational Information and Placement Techniques in Vocational Rehabilitation* (1-3)
- 501v. SEMINAR IN VOCATIONAL EDUCATION (1-12) Conferences, investigations, and discussion for advanced students and mature persons who have had experience as teachers, supervisors, or administrators.
- 506v. ADMINISTRATION OF VOCATIONAL EDUCATION (1-6) The job of the local director of industrial education in organizing and developing city and other local programs of industrial education. Prerequisite: 6 credits in industrial education or valid director's certificate, equivalent training and experience.
- 510v. VOCATIONAL EDUCATION FOR ADMINISTRATORS (2-3) Designed for school administrators and supervisors who desire an understanding of practical arts and vocational education. Prerequisite: I.Ed. 1v or trade or teaching experience.
- 550v. RESEARCH IN VOCATIONAL EDUCATION (2-3) Research techniques in vocational industrial education.
- 555v. CURRENT PROBLEMS IN VOCATIONAL EDUCATION (1-6) Recent trends and developments in part-time, full-time, and evening school education, involving critical analysis of objectives, content, and outcome.
- Unit A. *Changing Industrial, Economic, and Social Conditions* (1)
- Unit B. *Policies and Program of the American Vocational Association* (1)
- Unit C. *Federal and State Vocational Legislation, Present and Pending* (1)
- Unit D. *Financing Vocational Education* (1)
- Unit E. *Current Administrative Problems in Vocational Education* (1)
- Unit F. *Current Administrative Problems in Vocational Education (cont'd)* (1)
- 558v. FRONTIER PROBLEMS IN VOCATIONAL INDUSTRIAL EDUCATION (2-3 per unit)
- Unit A. *Federal Legislation* (2-3)
- Unit B. *Present-Day Local Personnel and Curriculum Problems* (2-3)
- Unit C. *State and Local Supervision and Administration* (2-3)
- 560v. PHILOSOPHY OF INDUSTRIAL EDUCATION (2-3) Principles and beliefs upon which progressive industrial education rests; basic concepts underlying practical arts and vocational education; literature for evaluating instructional practices. Prerequisite: 12 credits in industrial education or teaching experience.

INDUSTRIAL ENGINEERING

BENJAMIN W. NIEBEL, *Head of the Department*
203 Engineering C

The department offers graduate work leading to the M.S. degree. Graduate study and research are conducted in operations research, linear programming, queueing theory, and experimental design. Opportunities also exist for advanced study in automation, production engineering, product design for production, work measurement, costs and budgets, tool design, methods analysis, personnel management, and management controls.

In order to be admitted to graduate work in this field, the student must have been graduated from an accredited school with a major in industrial engineering. Graduates of other accredited engineering curriculums may be admitted after completing 27 credits in industrial engineering.

INDUSTRIAL ENGINEERING (I E)

400. ENGINEERING FOR PRODUCTION (3) *Mr. Niebel*
402, 402X. ENGINEERING ECONOMY (3) *Messrs. Anderson, Niebel, Roscoe, and Thuring*
404. SCIENTIFIC MANAGEMENT (2) *Messrs. Caldwell and Roscoe*
406. FACTORY PLANNING (2) *Messrs. Thuring and Linsky*
422a,b,c,d,e,f, 422a,b,c,d,e,fX. INDUSTRIAL ENGINEERING PROBLEMS (2-12) *Messrs. Anderson, Niebel, Thuring, Linsky, and Moss*
423. QUALITY CONTROL (2) *Messrs. Anderson and Thuring*
424. JOB EVALUATION (3) *Mr. Thomas*
425, 425X. METHODS OF INDUSTRIAL OPERATIONS RESEARCH (3) *Mr. Anderson*
429. PLASTIC WORKING OF METALS (3) *Mr. Roscoe*
430, 430X. INDUSTRIAL LEADERSHIP (3) *Mr. Caldwell*
432. INDUSTRIAL ENGINEERING LECTURES (1-3)
501. MANUFACTURING METHODS (2-8) Special projects including investigation; experimentation, design, and research of some one or more special types of manufacture. *Messrs. Niebel and Thuring*
502. MANAGEMENT METHODS (3-6) Scientific management, including management controls and mathematical programming; research on special problems. *Messrs. Anderson and Thuring*
503. PERSONNEL RELATIONS (2-8) Research on special topics. *Mr. Williamson*
505. GRAPHICAL COMPUTATION (2-6) Construction of natural and logarithmic scales, applications of various co-ordinate papers and construction of nomographic or alignment charts; determination of empirical formulae from engineering data. *Mr. Thuring*
506. TIME AND MOTION STUDY (3-9) Methods of research in motion and time study; critical analysis of current literature. *Mr. Anderson*
507. BUDGETARY CONTROL AND STANDARD COSTS (3-6) Divisional budgets as control media; establishing standard cost data, standard cost accounting procedures, and use of cost variances in controlling manufacturing operations. Prerequisite: I.E. 335.

INSTITUTION ADMINISTRATION

ESTHER A. ATKINSON

Head of the Department of Hotel and Institution Administration
4D Home Economics Building

The Department of Hotel and Institution Administration offers graduate work leading to the M.S. degree in institution administration. Prerequisite to graduate work is the completion of the following undergraduate work: 12 semester hours in the physical and biological sciences, 9 semester hours in the social sciences, 6 semester hours in foods and nutrition, and 9 semester hours in institution administration including one course in quantity food preparation.

HOTEL ADMINISTRATION (H A)

440. HOTEL OPERATIONAL LIABILITIES (2)

Mr. Bower

445. HOTEL ORGANIZATION AND OPERATION (3)

Mr. Bower

INSTITUTION ADMINISTRATION (IN A)

410. TEA ROOM MANAGEMENT (3)

437a,b,cS. SCHOOL CAFETERIA PROBLEMS (1-3)

Unit A. Nutrition and Menu Planning (1)

Unit B. Equipment (1)

Unit C. Organization and Management (1)

438. SCHOOL LUNCH ADMINISTRATION (3)

461. INSTITUTION ADMINISTRATION (3)

462. INSTITUTION EXPERIENCE (3)

502. PROBLEMS IN INSTITUTIONAL ADMINISTRATION (3-6) Individual study of problems in institutional administration. Prerequisites: In.A. 326, 330. *Miss Atkinson*

JOURNALISM

I. W. COLE, *Director of the School of Journalism*
114 Carnegie Hall

The School of Journalism offers graduate work leading to the M.A. degree in journalism with concentration on either editorial journalism or advertising.

The entering student should present the equivalent of an undergraduate major in journalism. Lacking this, he may make up the deficiency by completing basic undergraduate courses specified by the School. Up to 18 credits may be required. The deficiency also may be made up by submission of evidence of adequate professional experience in journalism, or by completion of examinations testing the student's knowledge of journalism fundamentals.

JOURNALISM (JOURN)

401. THE PRESS, ITS CRITICS AND ETHICS (3)

Mr. Marbut

416. ADVANCED COPY READING (3)

Messrs. Pockrass and Brown

JOURNALISM

424. ADVANCED REPORTING (3) *Mr. Marbut*
 430. SUPERVISION AND MANAGEMENT OF SCHOOL PUBLICATIONS (3)
 441. ADVANCED ADVERTISING COPYWRITING (3) *Messrs. Davis and Hicks*
 466. PUBLICITY AND PUBLIC RELATIONS PROBLEMS (3)
 480. PROBLEMS OF PUBLISHING (3) *Messrs. Markham and Vairo*
504. SEMINAR IN PENNSYLVANIA PRESS HISTORY (3) *Mr. Marbut*
505. INTERNATIONAL PRESS PROBLEMS (3-6) Legal and communications problems of the international flow of news and opinion; international press codes. *Mr. Markham*
506. SEMINAR IN COMMUNICATIONS RESEARCH METHODS (3-6) Social science measuring techniques for readership and advertising studies, media effectiveness, and propaganda results. *Mr. Markham*
513. CURRENT PROBLEMS IN NEWS REPORTING AND EDITING (3) Securing, writing, display, and treatment of the news; newsroom policies and ethics. *Mr. Marbut*
521. NEWS MEDIA AND PUBLIC OPINION (3) Problems in the function, techniques, and responsibilities of press, radio, and television in forming and interpreting opinion. Prerequisite: Pol.S. 427, Psy. 429, or Soc. 431. *Mr. Brown*
568. SEMINAR IN LEGAL PROBLEMS IN FREEDOM OF THE PRESS (3-6) *Mr. Marbut*

MATHEMATICS

ORRIN FRINK, *Head of the Department*
 210 Sparks Building

Graduate work leading to the M.A. and Ph.D. degrees is offered. To be admitted without undergraduate deficiency, an applicant should have credit for at least two advanced courses beyond integral calculus.

Graduate courses in all the principal branches of mathematics are offered each year. The department is equipped to direct research in a variety of fields, including function theory, abstract algebra, topology, number theory, statistics, numerical analysis, and all aspects of mathematical logic and foundations. A digital computer is available on the campus for students interested in numerical methods.

MATHEMATICS (MATH)

403. MODERN METHODS IN GEOMETRY (3)
 404. THEORY OF NUMBERS (3)
 405, 405X. PARTIAL DIFFERENTIAL EQUATIONS (3)
 407. FOUNDATIONS OF ALGEBRA AND GEOMETRY (3)
 408. APPLICATIONS OF MATHEMATICS (3)
 409-410, 409X-410X. PROBABILITY AND STATISTICS (3 each)
 411. FINITE DIFFERENCES (3)
 412S. ALGEBRAIC EQUATIONS (3)
 417. VECTOR ANALYSIS (3)
 419. ANALYTICAL MECHANICS (3)
 420-421. ADVANCED CALCULUS (3 each)

424. LEAST SQUARES (2)
425. CURVE FITTING (1)
431. DIFFERENTIAL EQUATIONS (3)
441. DETERMINANTS AND MATRICES (3)
- 451-452, 451X-452X. INTRODUCTION TO APPLIED MATHEMATICS (3-6 each)
453. MATHEMATICS FOR DIGITAL COMPUTERS (3)
471. FOUNDATIONS OF ALGEBRA (3)
472. FOUNDATIONS OF GEOMETRY (3)
481. VECTORS AND MATRICES (3)
500. ANALYTICAL MECHANICS (3) An exposition of rigid dynamics, the potential function, and Lagrange's equations. Prerequisite: Math. 419 or Phys. 461.
- 501-502. THEORY OF FUNCTIONS OF A REAL VARIABLE (3 each) Theory of real functions, sets, measure, derivatives, and integrals. Prerequisite: Math. 420.
503. FOURIER SERIES AND HARMONIC FUNCTIONS (3) Fourier series and integrals; spherical harmonics, Bessel functions, etc., with special emphasis on their applications. Prerequisites: Math. 44, 420.
505. INTEGRAL EQUATIONS (3) Fredholm and Volterra equations, and applications. Prerequisite: Math. 421.
507. CALCULUS OF VARIATIONS (3) Prerequisites: Math. 44, 421.
- 508-509. THEORY OF FUNCTIONS OF A COMPLEX VARIABLE (3 each) Development of the complex number system; theory of analytic functions. Prerequisite: Math. 421.
510. THEORY OF GROUPS (3) General properties of groups with applications. Prerequisite: Math. 471 or 535.
511. LINEAR ALGEBRA AND MATRIX THEORY (3) Vector spaces and linear transformations, canonical representations, elementary divisors and invariant factors. Prerequisite: Math. 481.
- 513-514. ADVANCED ANALYTIC GEOMETRY (3 each) Introduction of homogeneous coordinates and their use in the study of projective properties. Prerequisite: Math. 43.
- 520-521. PROJECTIVE GEOMETRY (3 each) General study of the subject from the postulational standpoint. Prerequisite: Math. 43. Alternate years or as required.
- 522-523. METRIC DIFFERENTIAL GEOMETRY (3 each) The usual classical treatment of the subject. Prerequisite: Math. 43.
- 530-531. TOPOLOGY (3 each) Topological spaces, combinatorial topology, applications to algebra and analysis.
534. THEORY OF ALGEBRAIC NUMBERS (3) Introduction to the number theory of quadratic fields, with study of the theory of ideals in quadratic and higher fields, with application. Prerequisites: Math. 404, 471.
- 535-536. MODERN ALGEBRAIC THEORIES (3 each) Groups, rings, ideals, algebraic number fields, Galois theory. Prerequisite: Math. 471.
- 542-543. THEORY OF STATISTICS (3 each) Univariate and multivariate distributions, sampling distributions, theory of estimation, statistical hypotheses. Prerequisites: Math. 409, 421.

MATHEMATICS

- 550-551. MATHEMATICAL LOGIC (3 each) The logical basis of mathematics and its ultimate nature. Prerequisite: Math. 471 or Phil. 428.
- 552-553. NUMERICAL METHODS (3 each) Procedures for practical calculation, including interpolation, solution of equations, iterative methods, harmonic analysis and use of modern calculating equipment. Prerequisite: Math. 420.
- 560-561. THEORY OF DIFFERENTIAL EQUATIONS (3 each) Prerequisites: Math. 44, 421.
570. SPECIAL TOPICS IN GEOMETRY (3-6)
571. SPECIAL TOPICS IN ANALYSIS (3-6)
572. SPECIAL TOPICS IN ALGEBRA (3-6)
573. SPECIAL TOPICS IN APPLIED MATHEMATICS (3-6)
574. SPECIAL TOPICS IN FOUNDATIONS OF MATHEMATICS (3-6)
- 575-576. MATHEMATICS SEMINAR (1-6 each) Selected topics from recent mathematical developments.

MECHANICAL ENGINEERING

NORMAN R. SPARKS, *Head of the Department*
208 Mechanical Engineering Building

The department offers graduate work leading to the M.S. and Ph.D. degrees. Graduate programs in this field emphasize heat power or machine design. Courses and facilities available permit studies in heat transfer, advanced machine design, internal combustion engines, machine dynamics, gas turbines and gas dynamics, lubrication, automatic control systems, and power generation and utilization.

The minimum undergraduate preparation for admission is an educational background approximately equivalent to that of graduates in mechanical engineering at this University. Applicants who cannot immediately satisfy this requirement, but who are otherwise qualified, will be given an opportunity to make up undergraduate deficiencies.

MECHANICAL ENGINEERING (M E)

- 401a,b,c,d. MECHANICAL ENGINEERING (3-12)
402. AIR CONDITIONING (3)
408. STEAM TURBINES (3)
409. GAS TURBINES (3)
410. POWER PLANTS (3)
- 411, 411X. REFRIGERATION (3)
- 412, 412X. FUNDAMENTALS OF HEAT TRANSFER (3)
413. INTERNAL COMBUSTION ENGINES (3)
416. RESISTANCE AND POWERING OF SHIPS (3)
417. THEORY OF ENGINEERING INSTRUMENTS (3)
450. DESIGN OF MACHINE TOOLS (3)
451. ADVANCED MACHINE DESIGN PROBLEMS (3)
452. MACHINE DESIGN ANALYSIS (3)

453. BEARING DESIGN AND LUBRICATION (3)
 455. AUTOMATIC CONTROL SYSTEMS (3)
 457. ADVANCED MECHANISMS (3)
502. ADVANCED GAS TURBINES (3-6) Thermodynamic and stress analysis design of gas turbine and compressor units. Prerequisite: M.E. 409.
504. ADVANCED ENGINEERING THERMODYNAMICS (3-6) Pure and applied thermodynamics including its application to advanced engineering problems; collateral reading and discussion of the classical works on the subject. Prerequisite: M.E. 32.
505. HEAT TRANSMISSION (3-6) Applications of principles of heat transfer to efficient design of mechanical engineering equipment. Prerequisite: M.E. 412.
506. MECHANICAL ENGINEERING SEMINAR (1-4) Advanced courses adapted to the individual requirements of graduates in mechanical engineering.
507. ADVANCED INTERNAL COMBUSTION ENGINES (3) Design and performance of both carburetor and fuel injection type reciprocating engines primarily from the thermodynamic viewpoint, with emphasis on the economics of operation. Prerequisites: M.E. 413, 504.
510. MIXTURE PREPARATION AND COMBUSTION IN INTERNAL COMBUSTION ENGINES (3-6) Performance and design of carburetors and injection systems; combustion and its control in spark-ignition and compression-ignition engines. Prerequisites: M.E. 413.
552. ADVANCED DYNAMICS OF MACHINES (3-6) Linear and torsional vibrations in and balancing of rotating and reciprocating machinery; exact analysis of stresses produced by these and other dynamic forces in machine parts. Prerequisites: E.Mch. 12, M.E. 54.
553. FRICTION AND LUBRICATION (3) The hydrodynamic theory of lubrication and methods of applying it to bearing design, together with a survey of methods of testing lubricants.
555. AUTOMATIC CONTROL SYSTEMS (3) Advanced problems and techniques in the design of automatic control systems with emphasis on stability, controller design, and optimum performance. Prerequisite: M.E. 455.
557. MECHANISM SYNTHESIS (3) Design and analysis of mechanisms for specific motion and energy requirements; intermittent mechanisms. Prerequisite: M.E. 457.
580. INVESTIGATION PROJECTS (2-6) Special experimental studies or investigations in mechanical engineering, adapted to individual requirements.

METALLURGY

AMOS J. SHALER, *Head of the Department*
 5 Mineral Sciences Building

The department offers studies leading to the M.S. and Ph.D. degrees. There is opportunity to specialize, both in research and in course work, in chemical metallurgy, physical metallurgy, mechanical metallurgy, or the science of metals. Minor

work in any of these specializations is available for students majoring in another field.

The requirements for admission are a satisfactory B.S. degree in metallurgy, metallurgical engineering, chemistry, chemical engineering, physics, mechanical engineering, or engineering mechanics; or a satisfactory bachelor's degree in another field, provided it has included the equivalents of mathematics through integral calculus, 8 credits of physics, 12 credits of chemistry, 10 credits of other scientific, engineering, or mineral science fields, and 10 credits of metallurgy. Students who lack some of these requirements may be admitted but are required to take the prerequisite courses without being able to apply them toward an advanced degree.

METALLURGY (METAL)

405. FERROUS METALLOGRAPHY (3)
 406. NONFERROUS METALLOGRAPHY (3)
 407. METALLURGICAL ENGINEERING I (3)
 408. METALLURGICAL ENGINEERING II (3)
 409. METALLURGICAL INVESTIGATIONS I (3)
 410. METALLURGICAL INVESTIGATIONS II (3)
 411. ADVANCED PHYSICAL METALLURGY (3)
 412. EXPERIMENTAL METALLURGY (3)
 413. ADVANCED CHEMICAL METALLURGY (3)
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501. METALLURGICAL PROBLEMS (1-6 per semester) Independent study of special problems in metallurgy. Prerequisites: Metal. 411, 413.
 502. SEMINAR IN METALLURGY (1-6) Conferences, reading, reports, and special lectures. *Mr. Shaler*
 515. CORROSION OF METALS (3) Phenomena and theories of metallic corrosion; principles of alloy selection for engineering and structural uses in corrosive environments. Prerequisites: Metal. 411, 413. *Mr. Read*
 516. FLOW AND FRACTURE OF SOLIDS (3) Phenomenological and theoretical treatment of flow and fracture in solids. *Mr. Shaler*
 518. CONSTITUTION OF METALLURGICAL SYSTEMS (3) Application of thermodynamic principles to study of heterogeneous equilibrium in alloy, slag, and slag-metal systems. Prerequisites: Metal. 411, 413. *Mr. Davis*
 519. ADVANCED FERROUS METALLURGY (3) Physicochemical principles in the smelting and refining of iron and steel; slag control; solidification and primary forging of steel. Prerequisites: Metal. 411, 413. *Mr. Davis*
 520. FOUNDRY METALLURGY (3) Principles of foundry metallurgy; application to foundry operations for various ferrous and nonferrous casting alloys. Prerequisites: Metal. 411, 413. *Mr. Lindsay*
 522. SOLID PHASE REACTIONS IN METALS (3) Mechanism and rate determining factors in solid phase reactions in metals; diffusion processes, nucleation theory, precipitations from solid solution, eutectoid decomposition and order-disorder phenomena. Prerequisites: Metal. 411, 413. *Mr. Lindsay*
 524. ADVANCED METAL WORKING (3) Elements of mathematical theory of plasticity; metal working processes; measurement of deformations in metal working; theory of metal working. Prerequisite: Metal. 516. *Mr. Shaler*

525. METAL FINISHING (3) Metallic coatings and their metallurgical properties; theories and problems of application, utilization, and evaluation. Prerequisites: Metal. 411, 413. Mr. Read

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in metallurgical studies are listed under Mineral Sciences in Part II of this bulletin.

METEOROLOGY

HANS NEUBERGER, *Head of the Department*
323 Mineral Industries Building

The department offers graduate programs leading to the M.S. and Ph.D. degrees. Candidates may specialize in aerosol and cloud physics, various phases of dynamic meteorology including turbulence and atmospheric circulation, atmospheric optics, macro- and microclimatology, agricultural meteorology, synoptic meteorology, or meteorological instrumentation.

Undergraduate requirements for admission include mathematics through differential equations, one year of college physics, and 12 credits in meteorology. Students may be admitted with deficiencies in some of the prerequisites but must make up such deficiencies before they are admitted to candidacy for a degree. This applies particularly to students with a strong background in mathematics, physics, or engineering.

METEOROLOGY (METEO)

- 411. SYNOPTIC METEOROLOGY I (3)
 - 412. SYNOPTIC METEOROLOGY II (3)
 - 418. INTRODUCTORY PHYSICS OF THE UPPER ATMOSPHERE (3)
 - 431. SYNOPTIC METEOROLOGY LABORATORY I (3)
 - 432. SYNOPTIC METEOROLOGY LABORATORY II (2-10)
 - 433. ADVANCED SYNOPTIC ANALYTICAL TECHNIQUES (3)
 - 443. PHYSICAL METEOROLOGY (3)
 - 445. HYDROMETEOROLOGY (3)
 - 450. APPLICATIONS OF STATISTICS TO METEOROLOGY (3)
 - 451. DYNAMIC METEOROLOGY I (3)
 - 452. DYNAMIC METEOROLOGY II (3)
 - 461. THEORY OF METEOROLOGICAL INSTRUMENTS (3)
 - 472. PHYSICAL AND DYNAMIC CLIMATOLOGY (3)
 - 492. METEOROLOGICAL SEMINAR (2)
500. METEOROLOGICAL SEMINAR (1-3) Discussion of meteorological reports and papers; scientific outlook. Prerequisites: Meteo. 412, 451.
502. SELECTED TOPICS OF ADVANCED METEOROLOGY (2) Current problems in meteorology. Prerequisite: a minimum of 15 credits in meteorology.
503. ATMOSPHERIC TURBULENCE (3) Atmospheric diffusion, heat conduction, friction, and evaporation; statistical properties of turbulence.

METEOROLOGY

504. ADVANCED DYNAMIC METEOROLOGY (3) Introduction to perturbation theory with application to gravitational and long waves; principles of dynamic-numerical forecast methods. Prerequisite: Meteo. 452.
505. BIOCLIMATOLOGY (2) Climatic phenomena in their relation to life. Prerequisite: Meteo. 472.
506. ADVANCED METEOROLOGICAL ANALYSIS (2-6) Physical analysis of atmospheric phenomena; synoptic analysis of weather phenomena for advanced students. Prerequisite: Meteo. 412.
507. DYNAMIC OCEANOGRAPHY (2) Physical properties of sea water; heat balance of the oceans; theory and observations of ocean currents, waves, and tides.
508. PHYSICS OF THE UPPER ATMOSPHERE (2) Temperature distribution, composition, and electrical characteristics of the upper atmosphere; theories of aurora and light of the night sky.
509. THEORETICAL CLIMATOLOGY (2) Theory of latitudinal, annual, and diurnal temperature changes; theories of climatic changes; microclimate.
510. CLOUD PHYSICS (2) Current theories on phase changes in clouds and mechanisms responsible for precipitation; techniques of cloud modification and control.

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in meteorological studies are listed under Mineral Sciences in Part II of this bulletin.*

MINERAL ECONOMICS

JOHN D. RIDGE, *Head of the Department*
207 Mineral Sciences Building

The department offers graduate work leading to the M.S. and Ph.D. degrees. A student may specialize in the economics of exploration for, and the extraction, beneficiation, and utilization of, the ferrous and nonferrous metals, the nonmetals, the fuels, and ground water. Work is also offered in property evaluation, analysis of mineral data, and the influence of technological advances on mineral economics.

The requirements for admission are 24 credits in chemistry, physics, and mathematics; 12 in geology, mineralogy, and/or the biological sciences; 9 in mineral economics, economics, commerce, and/or geography; and 6 in mining, metallurgy, petroleum engineering, ceramics, and/or industrial engineering.

Students having a deficiency of 9 credits or fewer in this total of 51 may be admitted as regular graduate students but will be required to make up such deficiencies without the credits being applicable toward the advanced degree.

MINERAL ECONOMICS (MN EC)

400. SEMINAR (1)
453. NONMETALLIC MINERALS (3)
463. MINERAL ECONOMY OF THE U.S.S.R. (3)
483. THE METALS AND THEIR ORES (3)

- 484. THE SOLID FUELS (3)
- 486. PETROLEUM AND NATURAL GAS ECONOMICS (3)
- 490. MINERAL VALUATION (3)
- 491. ANALYSIS OF MINERAL DATA (2)

- 500. ADVANCED PRINCIPLES OF MINERAL ECONOMICS (3-6) Economic history of mineral industries, research methods, economics of mineral exploitation and utilization, mineral policy.
- 501. RESEARCH IN MINERAL ECONOMICS (3-6) Investigation in specialized fields of research in mineral economics. Prerequisite: 3 credits in Mn.Ec. 500.
- 502. TECHNOLOGIC INFLUENCES (3-9) Relationship of technologic advancements to economic development of the mineral industries. Prerequisite: 3 credits in Mn.Ec. 500.
- 505. PROBLEMS OF MINERAL ECONOMICS (3-12) Determination of basic technologic-economic patterns of selected mineral industries. Prerequisite: 3 credits in Mn.Ec. 500.

MINERAL PREPARATION

H. BEECHER CHARMBURY, *Head of the Department*
4 Mineral Industries Building

The department offers graduate work leading to the M.S. and Ph.D. degrees. Areas in which students may specialize include the fundamentals of gravity, electrical, and chemical methods of beneficiating natural mineral deposits. Graduate work may also be undertaken on the properties of specific minerals as they are related to beneficiation.

Graduates with a B.S. degree in such scientific fields as chemistry, physics, and mathematics, and in such engineering fields as mining, metallurgy, ceramics, fuel technology, and mechanical, electrical, and civil engineering are eligible for admission to an advanced degree program in mineral preparation. However, graduates in the above fields are required to take 6 credits of undergraduate courses in mineral preparation along with their graduate program.

MINERAL PREPARATION (MN PR)

- 400. MINERAL PREPARATION SEMINAR (1)
- 403. FLOWSHEETS OF MINERAL PREPARATION PLANTS (2)
- 404. PLANT LAYOUT AND DESIGN (3)
- 405. UNIT OPERATIONS (3)
- 406. MINERAL PREPARATION TESTING (2)
- 410. COAL PREPARATION (3)

- 502. FROTH FLOTATION AND AGGLOMERATION (3) Intensive study of theory and applications of froth flotation and agglomeration. Prerequisite: Mn.Pr. 405. *Mr. Sun*
- 504. MINERAL PREPARATION RESEARCH (3-10) Research work on specific problems in mineral preparation. Prerequisite: Mn.Pr. 405 or 410. *Mr. Charmbury and Staff*

MINERAL PREPARATION

505. GRAVITY PROCESSES AND MISCELLANEOUS METHODS OF MINERAL PREPARATION (3) Intensive study of theory and applications of gravity, magnetic, electrostatic, centrifugal, and dense-media processes of mineral concentration. Prerequisite: Mn.Pr. 405. *Mr. Mitchell*

506. MINERAL PREPARATION PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mineral preparation plant projects. Prerequisite: Mn.Pr. 405. *Mr. Mitchell*

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in mineral preparation studies are listed under Mineral Sciences in Part II of this bulletin.*

MINERALOGY

JOHN C. GRIFFITHS, *Head of the Department*
114 Mineral Sciences Building

Graduate instruction and research leading to the M.S. and Ph.D. degrees is offered. Areas of specialization include igneous, sedimentary, and metamorphic petrology, mineralogy, crystal chemistry, X-ray mineralogy, clay mineralogy, ore mineralogy, and applications of statistics in the earth sciences.

The general requirements for admission are mathematics through integral calculus, chemistry through quantitative analysis, 10 credits of general physics, 30 credits of geology, petrology, and mineralogy including microscopical petrography (i.e., an equivalent to Min. 483, acceptable to the faculty).

Additional specific requirements must be fulfilled in most areas of specialization. Deficiencies may, in most cases, be made up after admission.

MINERALOGY (MIN)

460. OPTICAL MINERALOGY (3)

Mr. Wright

483. PETROGRAPHY (4)

Messrs. Griffiths and Thornton

500. OPTICAL CRYSTALLOGRAPHY OF MINERALS (3) Optical methods, microscopic techniques, and measurement of optical constants of crystals; theory and application of the universal stage. Prerequisite: Min. 460. *Mr. Wright*

501a. PETROLOGY (3-6) Microscopic study of rocks, emphasizing classification and genetic relationships. *Messrs. Krynine, Tuttle, and Griffiths*

502. MINERALOGICAL PROBLEMS (3) Original study of some limited mineralogical or petrological problems.

504. THEORETICAL MINERALOGY (2) Crystal chemistry and crystal physics applied to solid solution, polymorphism, crystal growth, and related phenomena. *Mr. Bates*

505. MINERALOGY SEMINAR (1-2) Reading, presentation, and discussion of literature dealing with various phases of theoretical mineralogy. Topics are selected to meet the interests of the majority of the students. *Messrs. Krynine, Tuttle, Bates, Griffiths, and Brindley*

- *510. METAMORPHIC PETROLOGY (2-6) Detailed review of chemical, mineralogical, and structural changes that take place during metamorphism. Prerequisite: Min. 483. *Mr. Thornton*
511. SEDIMENTARY PETROLOGY (3-4) Composition, texture, structure, mass properties of sediments; dynamic processes in complex natural systems; sedimentary stages: weathering, erosion, transport, deposition, and lithification. Prerequisite: Min. 483. Concurrent: Min. 513. *Mr. Krynine*
512. SEDIMENTARY PETROLOGY, CONTINUED (2-4) Diastrophism and tectonic background of sedimentation; depositional loci; classification of sediments: quartzites, graywackes, arkoses; chemical sediments; paleogeography, paleoclimatology, oil finding. Prerequisite: Min. 511. Concurrent: Min. 514. *Mr. Krynine*
513. METHODS OF ANALYSIS OF SEDIMENTS (2) Principles and practices used in analyzing sedimentary rocks for size, shape, and accessory (heavy) minerals. Concurrent: Min. 511. *Mr. Griffiths*
514. APPLIED SEDIMENTOLOGY (3) Design and control in analysis of sedimentary rocks; application of these techniques to industrial problems. Concurrent: Min. 512. *Mr. Griffiths*
516. PETROLOGY OF FINE-GRAINED SEDIMENTS (2-3) Fine-grained sedimentary rocks and their industrial applications. Prerequisite: Min. 530. *Mr. Griffiths*
- †517. SEDIMENTS OF THE WORLD (1-9) Microscopic and field studies of representative American and foreign rock suites; correlation with paleogeographic, geotectonic, economic data. Prerequisites: Min. 512, 514. *Mr. Krynine*
- ‡518. LIMESTONES AND DOLOMITES (2-6) End member concept in the study of composition, texture, structure, field distribution, and origin of carbonates and cherts. Prerequisite: Min. 483. *Mr. Krynine*
- ‡519. OIL RESERVOIR PETROLOGY (2-6) Petrographic fundamentals controlling porosity, storage capacity, oil accumulation, effective permeability, fluid yield and retention, exploration and production methods. Prerequisites: Min. 512, 514, 516. *Messrs. Krynine and Griffiths*
520. STUDY OF ACCESSORY MINERALS (2-4) Detailed study of accessory (heavy) minerals; their significance in problems of provenance, petrogenesis, mineral stratigraphy, and paleogeography. Prerequisites: Min. 511, 512, 513, 514. *Mr. Griffiths*
521. COLOR IN MINERALS (1-2) Nature of light absorption as a function of chemical composition for solutions, glasses, and minerals. *Mr. Weyl*
- ‡523. X-RAY DIFFRACTION STUDIES OF MINERALS (2-6) Investigation of mineralogical problems with X-rays. Practicum includes preparation of samples, use of X-ray apparatus, and interpretation of patterns. *Mr. Brindley*
524. INTRODUCTION TO SEDIMENTATION (3) Concurrent: Min. 483. *Mr. Krynine*
525. IGNEOUS PETROLOGY (2-6) Origin, distribution, and composition of igneous rocks. Prerequisite: Min. 483. *Mr. Tuttle*

* Credits to be arranged, 2-4 per semester.

† Credits to be arranged, 1-3 per semester.

‡ Credits to be arranged, 2-3 per semester.

MINERALOGY

530. (Cer.T. 530). STRUCTURE, PROPERTIES, AND OCCURRENCE OF CLAY MINERALS (2-5)
Structure analysis and identification of clay minerals; mineral transformations and behavior; occurrence, genesis, and petrography of fine-grained sediments.
Messrs. Griffiths, Bates, and Brindley

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in mineralogical studies are listed under Mineral Sciences in Part II of this bulletin.

MINING

ARNOLD W. ASMAN, *Head of the Department*
305B Mineral Industries Building

Graduate work is offered leading to the M.S. and Ph.D. degrees. Research and graduate work are available in underground stress analysis, drilling and blasting, mined materials handling, electric power for mines, mathematical analysis of mine layouts, ventilation network studies, mine operations programming, mine safety trends, dust control, roof support methods, continuous mining, mine illumination, mine production and cost control, and mine property valuation.

At least a B.S. degree in mining or some related engineering field is required for admission to graduate work. Students may be required to schedule certain prerequisite courses without degree credit.

MINING (MNG)

400. MINE SAFETY ENGINEERING (1)
471. MINE MECHANIZATION (3)
472. MINING DESIGN (3)
481. MINE VENTILATION (3)
484. MINE COST CONTROL (2)
488. ADVANCED MINE MECHANIZATION (2)
494. MINE MANAGEMENT ENGINEERING (3)
499. MINE PRODUCTION CONTROL (2)
500. MINING SEMINAR (2) Conferences, reading, and reports. Scientific management; public relations; technological developments. Required of all graduate students in mining engineering.
501. MINE ENGINEERING (3) Mine mechanization problems. Selection of the most suitable equipment for various conditions. Prerequisite: Mng. 488.
504. MINING RESEARCH (3-10 per semester) Research work on specific problems in physics of mining and mine mechanization. Prerequisite: Mng. 481.
506. MINE AND MINE PLANT DESIGN (3-10) Layout, design, and selection of equipment for specific mining and mine plant projects. Prerequisite: Mng. 499.
520. MINE PLANNING USING CYCLE STUDIES (3-6) Highly productive cycles of mine section operation are developed by use of time and method studies of the various sub-cycles involved. Prerequisite: Mng. 472.

521. MATHEMATICAL ANALYSIS OF MINE LAYOUTS (3) Proportioning layouts in regard to mineral available, distances, and centroids of mining areas; incremental and sub-cycle costs. Prerequisite: Mng. 488.
522. ROCK MECHANICS (3-6) Detailed study of the physical properties of rocks as affecting the design of underground openings; testing procedures, calculations, and design. Prerequisite: Mng. 499.
523. MINE DUSTS (3) Detailed studies of methods of collecting, sampling, and determining amount, size, and mineral content of dust in mine atmospheres; methods of dust control. Prerequisite: Mng. 481.
524. UNDERGROUND MINING POWER DISTRIBUTION SYSTEMS (3-6) Calculations involved in the design of power applications and systems for mines; electrical, compressed air; Diesels; package power for extremely gassy conditions; sectionalizing; loads and load centers. Prerequisite: Mng. 488.

NOTE: *Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in mining studies are listed under Mineral Sciences in Part II of this bulletin.*

MUSIC

HUMMEL FISHBURN, *Head of the Department*
217 Carnegie Hall

The department offers graduate work leading to the M.A. degree. Students may give emphasis to one of the following areas, or may elect a program including work in all of them: theory, performance, music literature, and creative music. The minor will be chosen from the liberal arts.

MUSIC (MUSIC)

407. PIANO REPERTOIRE (3)
408. VOCAL LITERATURE (3)
410. MUSIC OF THE 20TH CENTURY (3)
411. LITERATURE OF THE VIOLIN (3)
- 429-432. SINGER'S STYLE AND INTERPRETATION (3 per course) Fee \$25 per course.
456. ELEMENTARY COUNTERPOINT (3)
459. MODERN INSTRUMENTAL ARRANGING (3)
466. ADVANCED CONDUCTING (3)
- 503-506. ADVANCED STRINGED INSTRUMENTS (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 103-106. Fee \$25 per course.
- 511-514. ADVANCED PIANO (3 per course) Piano literature of all periods; stress laid on developing technique and preparing for public performance. Fee \$25 per course.
- 531-534. ADVANCED ORGAN (3 per course) Study, repertoire building, and recital performance. Prerequisite: Music 31-34. Fee \$30 per course.
543. MODERN HARMONY (3) Harmonic writing based on 20th century practices with attention to traditional idioms that serve as foundation.

MUSIC

557. SYMPHONIC STRUCTURE (3) Survey of the evolution and application of the forms used in symphony, sonata, concerto, string quartet, and related works. Prerequisite: Music 57.
- 558-561. FREE COMPOSITION (3 per course) Composition: vocal and instrumental, standard or modern idioms. Prerequisite: 18 credits in harmony, counterpoint, and piano.
563. FREE ARRANGING (3) Correct procedure in arranging for vocal and instrumental ensembles; practical exercises in quartets, glee clubs, and choruses; small instrumental groups, band, and orchestra. Prerequisite: 18 credits in harmony, including 3 of orchestration.
567. THE LITERATURE OF THE ORCHESTRA (3) The suite, symphony, tone poem, and overture from the point of view of appreciation, form, and orchestration. Prerequisites: Music 6 and theoretical knowledge of the key instruments of the orchestra.

MUSIC EDUCATION

HUMMEL FISHBURN, *Head of the Department*
217 Carnegie Hall

The department offers graduate work leading to the M.Ed. and D.Ed. degrees with a major in music education and a minor in music. The program for the master's degree includes some courses in general education, and the program for the doctor's degree includes considerable work in general education.

On the doctor's level, there may be course emphasis leading toward professional work in vocal, instrumental, or theoretical music on the elementary, secondary, or college level of teaching; but the degree requires work in all of these fields.

MUSIC EDUCATION (MU ED)

401. MUSIC IN THE RURAL AREA (3)
462. PEDAGOGY OF THEORY (3)
468. THE TEACHING OF PIANO (3)
469. BAND AND ORCHESTRA TECHNIQUE (3)
470. CHORAL TECHNIQUE (3)
- 475, 475X. OBJECTIVES AND PROBLEMS IN ELEMENTARY MUSIC EDUCATION (3)
480. CHORAL PROGRAM IN THE SECONDARY SCHOOL (3)
500. MUSIC EDUCATION SEMINAR (3-6) Problems of various phases of music education, both instrumental and vocal; research and literature dealing with these problems.
569. PRESENT-DAY TRENDS IN INSTRUMENTAL MUSIC (3) New methods and materials for band, orchestra, and ensembles.
571. VOCAL PEDAGOGY (3) Detailed study of vocal problems met in public schools, elementary through high school; vocal class pedagogy and literature; daily voice training. Prerequisites: Mu.Ed. 48, teaching experience.

572. INSTRUMENTAL PEDAGOGY (3-6) Research problems in band and orchestra. Prerequisite: Mu.Ed. 54 or practical experience.
573. THE MATERIALS OF APPRECIATION (3) Methods and materials for development of music appreciation in elementary and secondary schools. Prerequisites: Music 5, teaching experience.
- 574a,b. PRESENT-DAY TRENDS IN MUSIC EDUCATION (3-6) Present-day music education materials and methods (elementary and secondary levels) in relation to modern educational philosophy; emphasis upon practical problems presented by members of the class. Prerequisites: Mu.Ed. 48, teaching experience.
575. THE JUNIOR HIGH SCHOOL MUSIC CURRICULUM (3) Instructional materials, procedures, curricular and extracurricular activities, integration with other subjects.
576. MUSIC SUPERVISION (3) Current educational procedures in training music supervisors.
580. FIELD PROJECTS IN JUNIOR AND SENIOR HIGH SCHOOL MUSIC (3) Curricular problems to be carried on under actual school conditions; individual work under supervision. Prerequisites: teaching experience, 30 credits of graduate study.
594. PEDAGOGY OF EAR TRAINING (3) Materials and methods for training the listener to grasp, understand, and write what is heard from melody to four-part harmony. Prerequisite: 12 credits in ear training and/or harmony.

PETROLEUM AND NATURAL GAS ENGINEERING

ROBERT L. SLOBOD

Head of the Department of Petroleum and Natural Gas
26 Mineral Industries Building

The M.S. and Ph.D. degrees are offered with a major in petroleum and natural gas engineering. Areas of specialization include experimental and theoretical studies of water flooding and the newer methods for displacing oil from porous media, methods for calculating reservoir performance, scaled laboratory studies of reservoir phenomena, and drilling and well completion problems.

Students who expect to enter graduate study in this field with a degree in another curriculum should present 20 credits of chemistry and physics, 6 of geology, 15 of engineering science, and credit for mathematics through integral calculus. A limited number of deficiencies may be made up after admission.

Certain closely related courses outside the department may be counted as petroleum and natural gas credits toward the degree.

PETROLEUM AND NATURAL GAS (P N G)

420. EXPLOITATION AND DEVELOPMENT ENGINEERING (3)
481. NATURAL GAS AND GASOLINE PLANTS (3)
483. NATURAL GAS LABORATORY (1)
485. SECONDARY RECOVERY (3)
490. ADVANCED CORE TESTING (3)

PETROLEUM AND NATURAL GAS ENGINEERING

500. PETROLEUM AND NATURAL GAS ENGINEERING PROBLEMS (3-9 per semester)
501. ENERGETICS OF PETROLEUM ENGINEERING (3) Applications of thermodynamics to special problems in production of petroleum and natural gas.
502. PETROLEUM AND NATURAL GAS ENGINEERING SEMINAR (3-9) Intensive study of one or several phases of petroleum engineering.
503. THE FLOW OF HOMOGENEOUS FLUIDS THROUGH POROUS MEDIA (3) Flow and pressure distributions for various geometric patterns for steady and unsteady states. Prerequisite: Math. 431.
504. WATER FLOODING (3-6) Continuation of P.N.G. 485 with emphasis on special problems. Prerequisite: Chem. 460.
506. ADVANCED PETROLEUM ENGINEERING (5) Advanced problems in petroleum and natural gas production. Prerequisites: Chem. 461, P.N.G. 310.
507. CONDENSATE FIELDS (2) Retrograde condensation phenomenon of hydrocarbon mixtures at high pressures; literature on condensate fields; production methods and equipment design: casing heads, compressors, separators, stabilizers; safety measures. Prerequisite: P.N.G. 501.
508. COLLOIDAL BEHAVIOR OF INDUSTRIAL CLAYS, MUDS, AND SLIMES (2-3) Principles of colloidal activity applied to control of properties of clay slips, drilling fluids, and similar suspensions. (In co-operation with the Ceramic Technology staff.) Prerequisite: Chem. 461.
509. ADVANCED PETROLEUM ENGINEERING DESIGN (2) Continuation of P.N.G. 320. Projects in selection of engineering materials for casing programs, drilling rigs; production, treatment, stabilization, and transportation of crude oils. Prerequisite: P.N.G. 320.

NOTE: Courses in the use of X-ray diffraction, electron microscopy, and spectroscopy in petroleum and natural gas studies are listed under Mineral Sciences in Part II of this bulletin.

PHILOSOPHY

ERNEST H. FREUND, *Head of the Department*
217 Sparks Building

The department offers graduate work leading to the M.A. degree. A student may concentrate on history of philosophy, logic and scientific method, or value theory. Undergraduate preparation should include a major in philosophy, but a strong minor may also be acceptable.

PHILOSOPHY (PHIL)

401. RELIGIOUS PHILOSOPHY OF THE GREAT REFORMERS (3)
- 404X. ADVANCED HISTORY OF PHILOSOPHY (3)
406. MEDIEVAL PHILOSOPHY (3)
410. STUDIES IN GREEK PHILOSOPHY (3-6)
411. STUDIES IN MODERN PHILOSOPHY (3-6)

- 414. AESTHETIC THEORY (3)
- 418. RECENT AND CONTEMPORARY PHILOSOPHY (3)
- 419. PHILOSOPHICAL BACKGROUNDS OF AMERICAN THOUGHT (3)
- 425. PHILOSOPHY OF LAW (3)
- 426. METAPHYSICS (3)
- 427. ADVANCED ETHICS (3)
- 428. ADVANCED LOGIC (3)
- 429. SEMANTICS: PHILOSOPHY OF LANGUAGE AND SYMBOLISM (3)
- 430. PHILOSOPHICAL PROBLEMS (3-6)
- 450. TYPES OF PHILOSOPHY (3)

- 500a,b. ETHICAL SEMINAR (2-6) Critical study of some phase of ethical fact and theory.
- 501a,b,c,d. PHILOSOPHY SEMINAR (2-12) Meets the demand for advanced study in special fields of philosophical thought.
- 503. LOGIC (3) The logical basis of mathematics and its ultimate nature.
- 504. SOCIAL AND POLITICAL PHILOSOPHY (3) Critical study of basic problems in their historical and functional setting.
- 505. IDEALS OF WESTERN CIVILIZATION (3) Analysis of contemporary ideals in terms of their Graeco-Judean bases.
- 507. SEMINAR IN HISTORY OF WESTERN PHILOSOPHY (3-12)
- 510. CLASSICS OF SCIENTIFIC METHOD (3) Actual reasoning and procedures of historical masters of scientific methods.
- 511. PRINCIPLES OF EXPERIMENTAL INFERENCE (3) Science as controlled inquiry; types of scientific procedures in formal, physical, and sociocultural science.

PHYSICAL EDUCATION

JOHN D. LAWTHER

Assistant Dean of the College of Physical Education and Athletics
246 Recreation Building

Programs are offered leading to the M.Ed., M.S., D.Ed., and Ph.D. degrees. Areas of specialization include: (1) history, philosophy, and principles; (2) applied science (physiology of exercise, kinesiology, body mechanics); (3) organization and administration; (4) objectives, programs, methods, and evaluation; (5) adaptives and correctives; (6) health; and (7) athletics, intramural and interschool. The master's candidate is expected to acquire a basic minimum of knowledge in each of these areas with little specialization except for his thesis or problem. The doctoral candidate is expected to focus on one area during his final year of graduate work.

The requirements for admission to the M.Ed. program are 24 semester hours in professional health and physical education and 24 in education and psychology, including general psychology, educational psychology, principles and methods of teaching, education electives, and practice teaching.

The requirements for admission to the M.S. program are 36 semester hours in professional health and physical education and 18 in education and psychology. An

PHYSICAL EDUCATION

excellent background in the biological and physical sciences may satisfy up to half of the requirement in professional health and physical education.

PHYSICAL EDUCATION (PH ED)

424. MODERN TRENDS IN HEALTH AND PHYSICAL EDUCATION, RECREATION EDUCATION, AND ATHLETICS (3)
- 429S. THE MODERN DANCE IN EDUCATION (3)
- 431S. COACHING OF ADVANCED BASEBALL (3)
- 436S. COACHING OF ADVANCED FOOTBALL (3)
- 437S. COACHING OF ADVANCED BASKETBALL (3)
- 438S. COACHING OF ADVANCED TRACK (3)
- 439S. COACHING OF ADVANCED SOCCER (3)
- 440S. COACHING OF ADVANCED GYMNASTICS (3)
- 441S. ADVANCED COACHING OF ATHLETICS FOR MEN (1-11)
- Unit A. Basketball (1)*
 - Unit B. Football (1)*
 - Unit C. Track and Field (1)*
 - Unit D. Baseball (1)*
 - Unit E. Wrestling (1)*
 - Unit F. Soccer (1)*
 - Unit G. Swimming (1)*
 - Unit H. Gymnastics (1)*
 - Unit I. Boxing (1)*
 - Unit J. Lacrosse (1)*
 - Unit K. Fencing (1)*
- 449S. ADVANCED TEACHING OF SPORTS AND RHYTHMICS (1-11)
- Unit A. Soccer and Speedball (1)*
 - Unit B. Basketball (1)*
 - Unit C. Field Hockey (1)*
 - Unit D. Archery (1)*
 - Unit E. Swimming (1)*
 - Unit F. Rhythmics for Children (1)*
 - Unit G. Modern Dance and Accompaniment (1)*
 - Unit H. Early American Country Dancing and Social Dancing (1)*
 - Unit I. Tennis (1)*
 - Unit J. Badminton (1)*
 - Unit K. Golf (1)*
- 452S, 452X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE ELEMENTARY SCHOOL (3)
- 453S, 453X. ANALYSIS OF PHYSICAL EDUCATION ACTIVITIES FOR THE HIGH SCHOOL (3)
454. THE NATURAL PROGRAM OF PHYSICAL EDUCATION ACTIVITIES, APPLIED (3)
455. SCIENTIFIC METHOD IN HEALTH AND PHYSICAL EDUCATION (3)
460. METHODS AND PRINCIPLES OF ATHLETIC COACHING (3)
- 466S. VISUAL INSTRUCTION IN ATHLETICS (3)
- 471S. HEALTH AND PHYSICAL EDUCATION, RECREATION EDUCATION, AND ATHLETICS FOR THE SCHOOL ADMINISTRATOR (3)
- Unit A. Athletics in the Schools (1)*
 - Unit B. Health Education in the Schools (1)*
 - Unit C. Physical Education and Recreation Education in the Schools (1)*
480. ADVANCED ANATOMY AND PHYSIOLOGY, APPLIED (3)
- 482, 482X. POSTURE EDUCATION IN THE SCHOOLS (3)
- 488S. THE ADMINISTRATION OF PHYSICAL EDUCATION AND ATHLETICS FOR WOMEN (3)

489. INTRAMURAL ATHLETICS (3)
490. INTRODUCTION TO TESTS AND MEASUREMENTS IN HEALTH AND PHYSICAL EDUCATION (3)
491. ORGANIZATION AND ADMINISTRATION OF HEALTH AND PHYSICAL EDUCATION IN SCHOOLS (3)
500. PROBLEM IN PHYSICAL EDUCATION (3) Prerequisite: Ph.Ed. 455.
522. ORGANIZATION AND ADMINISTRATION OF PHYSICAL EDUCATION IN COLLEGES AND UNIVERSITIES (3) Administration of physical education in college; credits, schedules, excuses, records, reports, budgets, classification, tests, staff, and facilities. Prerequisite: Ph.Ed. 491.
523. ADMINISTRATION OF COLLEGE ATHLETICS (3) Eligibility, schedules, managerial systems, relationships of athletics to the physical education program and to education in general. Prerequisite: Ph.Ed. 491.
526. ATHLETIC PROBLEMS IN SCHOOLS (3) Practical problems which result from administration of athletics in schools. Reports on some aspects of athletics required. Prerequisite: Ph.Ed. 460.
528. PROFESSIONAL EDUCATION OF TEACHERS OF HEALTH AND PHYSICAL EDUCATION (3) Health and physical education surveys, publicity, sociability and personality tests, legislation, state certification, standards for facilities and equipment, in-service, follow-up, and teacher-community problems. Prerequisite: Ph.Ed. 491.
529. SUPERVISION OF PHYSICAL EDUCATION IN SCHOOLS (3) Methods and policies of the school supervisor of physical education; conferences, planning and presenting the program, evaluating results, improving teachers-in-service, supervision of the classroom teacher. Prerequisite: Ph.Ed. 491.
530. RESEARCH TECHNIQUES IN HEALTH AND PHYSICAL EDUCATION AND RECREATION EDUCATION (3) Prerequisite: Ph.Ed. 490.
531. RESEARCH IN HEALTH AND PHYSICAL EDUCATION AND RECREATION EDUCATION (3) Prerequisite: Ph.Ed. 530.
532. TESTS AND MEASUREMENTS IN PHYSICAL EDUCATION (3) Critical study of tests and measurements available in physical education; methods of constructing and evaluating new tests and measurements. Prerequisite: Ph.Ed. 490.
534. STUDIES IN CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION (3) Principles and methods of curriculum building in physical education; different psychological and educational points of view, organizing a course of study committee, making units of instruction. Prerequisite: Ph.Ed. 454.
535. MODERN FOREIGN SYSTEMS OF PHYSICAL EDUCATION (3) Comparative analysis of national and local programs and systems of physical education in foreign countries. Prerequisites: Ph.Ed. 534, 595.
536. SCIENTIFIC METHODS IN ATHLETIC COACHING (3) Unusual techniques in athletic coaching which are not commonly recognized and used; advanced skills and strategy in coaching major sports. Prerequisite: Ph.Ed. 460.
550. SEMINAR IN HEALTH AND PHYSICAL EDUCATION AND RECREATION EDUCATION (1-6) Open only to students preparing approved theses.
555. RELATIONSHIPS OF PHYSICAL EDUCATION TO THE EXACT SCIENCES (3)

PHYSICAL EDUCATION

560. ADMINISTRATIVE PROBLEMS OF PHYSICAL EDUCATION IN SCHOOLS (3) Solutions to problems emerging from the administration of physical education in schools, fitting physical education into the school's schedule, awards and budgets. Prerequisite: Ph.Ed. 491.
581. PROBLEMS IN BODY MECHANICS (3) Certain aspects of human motion and body segmental alignment; analysis of human gait, and the dynamic adaptation of the spine, thorax, and pelvis to external physical forces. Prerequisite: Hl.Ed. 244, Ph.Ed. 399.
595. PHILOSOPHY OF HEALTH AND PHYSICAL EDUCATION AND RECREATION EDUCATION (3) Prerequisite: Hl.Ed. 453 or Ph.Ed. 491 or Rc.Ed. 465.

PHYSICAL SCIENCE

HENRY W. KNERR

Chairman of the Committee on Physical Science
116 Willard Hall

The degree is offered with a major in physical science. The program, which is designed to meet the needs of secondary school science teachers, consists of at least 24 credits chosen from chemistry, geology, mathematics, and physics and a minor of at least 6 credits in basic education. A candidate is expected to complete at least one course in each of the four sciences and at least 12 credits in one of them. Appropriate courses are regularly offered in the summer, but are rarely available during the academic year.

As a minimum requirement for admission a student is expected to have had 10 credits in chemistry, 8 credits in physics, mathematics through trigonometry, and 27 credits in education, including educational psychology and practice teaching.

PHYSICS

JOHN A. SAUER, *Head of the Department*
101 Osmond Laboratory

The department offers graduate work leading to the M.S. and Ph.D. degrees. Graduate instruction and research opportunities are available in visible and infrared spectroscopy, crystal structure, solid state, field emission, acoustics, high-pressure physics, biophysics, electronics, shock waves, low-temperature physics, nuclear physics, physics of high polymers, and various phases of theoretical physics.

A bachelor's degree in physics or an allied field is required for admission. Students who lack some of the usual upper-class undergraduate courses in physics may be requested to take additional course work without degree credit.

PHYSICS (PHYS)

400. INTERMEDIATE ELECTRICITY AND MAGNETISM (4)
402. ELECTRONICS (4)
404. ELECTRONIC MEASUREMENTS (2-4)
406. NUCLEAR PHYSICS (3)

- 411. THEORETICAL MECHANICS (3)
- 412, 412X. THEORY OF THE SOLID STATE (3)
- 417. THE TEACHING OF PHYSICS (3)
- 420. INTERMEDIATE HEAT (3)
- *433. MECHANICS AND FLUID PHYSICS (3)
- *435. ELECTRICITY AND MAGNETISM (3)
- *436. OPTICS (3)
- *437. HEAT, WAVE MOTION, AND SOUND (3)
- *439. ELEMENTARY SURVEY OF MODERN PHYSICS (3)
- 441. DEMONSTRATION EXPERIMENTS (3)
- 443. INTERMEDIATE ACOUSTICS (3)
- 444. MEASUREMENTS IN ACOUSTICS (2)
- 454, 454X. ATOMIC AND NUCLEAR PHYSICS (3)
- 456. ATOMIC AND NUCLEAR PHYSICS (3)
- 457. EXPERIMENTAL ATOMIC PHYSICS (2)
- 458. INTERMEDIATE OPTICS (4)
- 461. THEORETICAL MECHANICS (3)
- 467. INTERMEDIATE ELECTRICITY AND MAGNETISM (3)
- 473-474. BIOPHYSICS (3 each)
- 477. X-RAY ANALYSIS OF SOLIDS AND LIQUIDS (3)

- 507. THERMODYNAMICS AND KINETIC THEORY (3) Classical and modern thermodynamics; introduction to statistical mechanics.
- 509. PHYSICS SEMINAR (1-3 per semester) Topics from current research.
- 512-513. SOLID STATE PHYSICS (3 each) Analytical treatment of physical properties of solids: crystal structure, X-ray diffraction, lattice vibrations, paramagnetism, ferromagnetism, ferroelectricity; electron theory of metals, semi-conductors. Prerequisite: Phys. 530.
- 517. STATISTICAL MECHANICS (3) Classical and quantum statistics, theory of ensembles, degenerate gases, applications to low temperature effects and co-operative phenomena. Prerequisites: Phys. 507, 561.
- 521. CRYSTAL STRUCTURE (3) Crystal symmetry, X-ray scattering, theory and techniques of crystal structure determination.
- 522. ADVANCED CRYSTAL ANALYSIS (3) Phase-determining methods in crystal analysis.
- 530. THEORETICAL MECHANICS (4) Newtonian mechanics; Lagrange's equations, Hamilton's principle; Hamilton's equations; coupled systems; waves in strings, central field problem; rigid bodies; elasticity; hydrodynamics.
- 532. ADVANCED THEORETICAL MECHANICS (3) Least action principle; canonical transformation; Lagrange and Poisson brackets; Hamilton-Jacobi equations; classical theory of fields. Prerequisite: Phys. 530.
- 533. THEORETICAL ACOUSTICS (3) Vibrating systems; transmission of disturbances through elastic and visco-elastic media. Prerequisite: Phys. 530.

* Phys. 433, 435, 436, 437, and 439 are courses of intermediate scope and difficulty and are intended primarily for high school and other teachers who have had only one year of general physics in college and who wish to make a thorough review of and an advance in this field.

These four courses taken together form a connected sequence covering the entire field of general college physics. Any course may be taken without the others, but it is preferable that they be taken in sequence or concurrently.

PHYSICS

- 553-554. NUCLEAR PHYSICS (3 each) Discussion and theoretical interpretation of basic experiments involving atomic nuclei and nuclear radiations. Prerequisite: Phys. 562.
557. ELECTRICITY AND MAGNETISM (3) Electro- and magnetostatics, Maxwell's equations, boundary value problems, electric and magnetic properties of material media.
558. ADVANCED ELECTRICITY AND MAGNETISM (3) Energy and momentum in the field, radiation theory, classical relativistic electron theory. Prerequisite: Phys. 557.
560. RESEARCH PROBLEMS (1-18) Introduction to research through individual assignments.
- 561-562. QUANTUM MECHANICS (3 each) The basic theory of wave and matrix mechanics, approximation methods, applications. Prerequisite: Phys. 530.
571. ATOMIC PHYSICS (3) Experimental basis of modern physics; atomic spectra and structure, nuclear phenomena.
572. SELECTED TOPICS IN SPECTROSCOPY (3) Atomic and molecular spectra, experimental methods and theoretical analyses.
575. SPECIAL TOPICS (1-3 per semester) Theoretical studies in any field of modern physics with or without associated experimental work. Prerequisite: Phys. 456.

PLANT PATHOLOGY

HENRY W. POPP

Head of the Department of Botany and Plant Pathology
206 Buckhout Laboratory

The M.S. and Ph.D. degrees are offered in this field. The student may specialize in the study of plant diseases caused by fungi, bacteria, or viruses, and/or in their control, especially by plant breeding or by chemical means.

For admission a student must present at least 27 credits in botany, plant pathology, and biological science, of which not more than 6 may be in biological science. As many as 6 credits may be made up as undergraduate deficiencies after the candidate has been admitted to the Graduate School.

Courses in plant pathology are listed under botany. See especially Bot. 408, 412, 419, 421, 428, 501, 509, 515, 519, 520, 521, 522, 523, 526, 529, 530, and 531.

POLITICAL SCIENCE

ELTON ATWATER, *Head of the Department*
120 Sparks Building

The M.A. and Ph.D. degrees are offered in this field. Students may specialize in American government, political theory, international relations, or comparative government. A Master of Public Administration degree is also offered in a special program built around Pol.S. 560, 561, and 562S.

For admission to graduate work students should present 12 to 15 hours of undergraduate work in the field, or its equivalent.

POLITICAL SCIENCE (POL S)

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| 411. AMERICAN POLITICAL THEORY (3) | <i>Mr. Riemer</i> |
| 413. GOVERNMENT AND POLITICS OF THE SOVIET UNION (3) | <i>Mr. Atwater</i> |
| 414. FOREIGN POLICY OF THE SOVIET UNION (3) | <i>Mr. Aspaturian</i> |
| 415. INTERNATIONAL ORGANIZATION (3) | <i>Mr. Aspaturian</i> |
| 416. INTERNATIONAL LAW (3) | <i>Mr. Aspaturian</i> |
| 417. MUNICIPAL GOVERNMENT (3) | <i>Mr. Corter</i> |
| 419. PUBLIC ADMINISTRATION (3) | <i>Mr. McGeary</i> |
| 421. MODERN POLITICAL THEORIES (3) | <i>Mr. Riemer</i> |
| 424S. STATE GOVERNMENT IN THE UNITED STATES (3) | |
| 426. POLITICAL PARTIES (3) | <i>Miss Silva</i> |
| 427. PUBLIC OPINION AND PROPAGANDA (3) | <i>Miss Silva</i> |
| 428. PENNSYLVANIA LOCAL GOVERNMENT (3) | <i>Mr. Corter</i> |
| 429. PENNSYLVANIA LOCAL ADMINISTRATION (3) | <i>Mr. Corter</i> |
| 431. ANCIENT AND MEDIEVAL POLITICAL THEORIES (3) | <i>Mr. Riemer</i> |
| 432. CURRENT POLITICAL TRENDS AND PROBLEMS IN THE UNITED STATES (3-9) | |
| | <i>Messrs. Riemer and Sorauf, Miss Silva</i> |
| 433. LABOR AND WELFARE LEGISLATION AND ADMINISTRATIVE PROBLEMS (3) | |
| | <i>Mr. Brewster</i> |
| 435. GOVERNMENT HOUSING, PLANNING, AND PUBLIC WORKS (3) | <i>Mr. Brewster</i> |
| 442. AMERICAN FOREIGN POLICY (3) | <i>Mr. Atwater</i> |
| 444. GOVERNMENT REGULATION (3) | <i>Mr. Ferguson</i> |
| 445. ADMINISTRATIVE LAW (3) | <i>Mr. Brewster</i> |
| 446. JUDICIAL SYSTEMS (3) | <i>Mr. Law</i> |
| 450. GOVERNMENT AND FOREIGN POLICIES OF BRITAIN AND THE COMMONWEALTH (3) | |
| 456. GOVERNMENTS AND FOREIGN POLICIES OF LATIN AMERICA (3) | <i>Mr. Law</i> |
| 458. GOVERNMENTS AND FOREIGN POLICIES OF THE FAR EAST (3) | <i>Mr. Aspaturian</i> |
| 499X. FOREIGN STUDY IN GOVERNMENT (2-6) | |
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| 500. SEMINAR IN POLITICAL SCIENCE (3-12) Subject to be announced. | <i>Mr. Brewster</i> |
| 505. SEMINAR IN ADVANCED AMERICAN GOVERNMENT (3-12) | |
| 508. RESEARCH IN PUBLIC ADMINISTRATION (3-12) | <i>Mr. McGeary</i> |
| 509. RESEARCH TECHNIQUES IN POLITICAL SCIENCE (3) | <i>Miss Silva</i> |
| 510. POLITICAL AND ADMINISTRATIVE PROBLEMS IN PENNSYLVANIA (3-6) | <i>Mr. McGeary</i> |
| 512. COMPARATIVE GOVERNMENT (3-12) | <i>Mr. Atwater, Miss Silva</i> |
| 515. INTERNATIONAL RELATIONS (3-6) | <i>Mr. Atwater</i> |
| 517. INTERNATIONAL ORGANIZATION (3-6) | <i>Mr. Aspaturian</i> |
| 519. PUBLIC ADMINISTRATION (3-6) | <i>Mr. McGeary</i> |
| 521. POLITICAL THEORY (3-6) | <i>Mr. Riemer</i> |
| 535. GOVERNMENT REGULATION (3-6) | |
| 560. PUBLIC MANAGEMENT I (15) Organization, management, personnel, budgeting, accounting, and other fiscal procedures in government at all levels. | |

POLITICAL SCIENCE

561. PUBLIC MANAGEMENT II (15) Administrative law, communications and report writing, statistics, public relations, public works administration, and planning in government at all levels. Prerequisite: Pol.S. 560.
- 562S. PUBLIC MANAGEMENT III (6) Supervised internship and report. Prerequisite: Pol.S. 561.

POULTRY HUSBANDRY

ERNEST W. CALLENBACH, *Head of the Department*
103 Weaver Hall

Graduate study programs lead to the M.S. and Ph.D. degrees in the following areas of specialization: poultry nutrition, poultry management, poultry products, poultry breeding, or animal behavior. In each area the program consists of a joint major between the Department of Poultry Husbandry and one or more basic science departments. Admission requirements vary according to the area of specialization. Students with undergraduate majors in the basic sciences may qualify.

POULTRY HUSBANDRY (P H)

401. (Psy. 401, Zool. 401). ANIMAL BEHAVIOR (3) *Mr. Hale*
412. POULTRY BREEDING (3) *Mr. Maw*
502. ADVANCED POULTRY NUTRITION (2-4) Prerequisite: P.H. 3. *Mr. Murphy*
503. ADVANCED POULTRY FARM MANAGEMENT (2-4) Prerequisite: P.H. 8. *Mr. Bressler*
504. ADVANCED MARKET POULTRY AND EGGS (2-4) Prerequisites: P.H. 1, 7; Ag.Ec. 33 or 2 additional credits in poultry husbandry. *Mr. Margolf*
505. RESEARCH IN POULTRY HUSBANDRY (1-15 per semester) Prerequisite: 9 credits in poultry husbandry. *Mr. Callenbach and Staff*
506. SEMINAR IN POULTRY HUSBANDRY (1-6) *Mr. Callenbach and Staff*

PSYCHOLOGY

CLARENCE R. CARPENTER, *Head of the Department*
112 Burrowes Building

The department offers graduate work leading to the M.S. and Ph.D. degrees. In special cases the M.Ed. and the D.Ed. may be obtained.

Areas in which a student may specialize are: (1) clinical psychology, which includes professional training for mental hygiene clinics, colleges, and institutions; (2) educational and developmental psychology, which prepares for college teaching, teacher education, and educational clinics; (3) experimental and general psychology, which prepares for college teaching and for academic and professional specialties; (4) school psychology, which prepares for work in the public schools and for the

Pennsylvania State Certificate as a Public School Psychologist; (5) industrial and business psychology, which prepares for positions in the application of psychology to business, industry, institutions, and state and federal agencies; (6) social psychology, which prepares for college teaching, work in applied social psychology—group dynamics, delinquency, attitude studies, and communications; and (7) psychological measurements and statistics, which provides basic skills for college teaching, work in admission and evaluation programs, test publishing organizations, state and federal agencies, and for most of the areas listed above.

Requirements for admission include a broad undergraduate preparation, a junior-senior scholastic average of approximately B, a minimum of 12 credits in psychology, and a satisfactory graduate student rating on a scholastic aptitude examination. Applicants with a master's degree will have their admission evaluated with emphasis on the quality of their graduate program.

PSYCHOLOGY (PSY)

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| 400. HONORS COURSE IN PSYCHOLOGY (2-6) | |
| 401. (P.H. 401, Zool. 401). ANIMAL BEHAVIOR (3) | Mr. Hale |
| 403. INTRODUCTORY PHYSIOLOGICAL PSYCHOLOGY (3) | Mr. Slivinske |
| 407. INTERMEDIATE EXPERIMENTAL PSYCHOLOGY (3) | Mr. Lepley |
| 411, 411X. PSYCHOLOGY OF THE PRESCHOOL CHILD (3) | Mr. Whaley |
| 412, 412X. ABNORMAL PSYCHOLOGY (3) | Mr. Guthrie |
| 414, 414X. INTERMEDIATE EDUCATIONAL PSYCHOLOGY (2-3) | Mr. Thevaos |
| 415, 415X. INTERMEDIATE STATISTICS IN PSYCHOLOGY AND EDUCATION (3) | Mr. Ray |
| 417. SOCIAL PSYCHOLOGY (2-3) | Mr. Carpenter |
| 418. MEASUREMENT OF PERSONALITY (3) | |
| 419. GUIDANCE AND EDUCATION IN SEXUAL AND MARITAL ADJUSTMENT (3) | Mr. Adams |
| 420. APPLIED SOCIAL PSYCHOLOGY (3) | Mr. Carpenter |
| 422. PSYCHOLOGICAL METHODS OF MEASURING THE REACTIONS OF THE PUBLIC (3) | Mr. Guest |
| 423. TEST CONSTRUCTION AND STANDARDIZATION (2-3) | Mr. Ray |
| 425, 425X. PSYCHOLOGY OF THE ELEMENTARY SCHOOL CHILD (2-3) | Mr. van Ormer |
| 426, 426X. ADOLESCENCE (2-3) | Mr. Thevaos |
| 427. PSYCHOLOGICAL PRINCIPLES IN ADVERTISING (3) | Mr. Guest |
| 428. OPINION RESEARCH LABORATORY (3) | Mr. Guest |
| 429. PSYCHOLOGY OF COMMUNICATION (3) | Mr. Slivinske |
| 431, 431X. INDUSTRIAL PSYCHOLOGY (3) | Mr. Smith |
| 432, 432X. INTRODUCTORY ENGINEERING PSYCHOLOGY (3) | Mr. Corso |
| 436, 436X. MENTAL HYGIENE IN SCHOOLS (3) | Mr. Gorlow |
| 437, 437X. PSYCHOLOGY OF ADJUSTMENT (3) | Messrs. Gorlow and Grosslight |
| 438. THEORY OF PERSONALITY (3) | Mr. Siegel |
| 440. PSYCHOLOGY PROJECTS (1-6) | |
| 441. INDUSTRIAL MOTIVATION AND MORALE (3) | |
| 445. (C.D.F.R. 445). DEVELOPMENT THROUGHOUT ADULTHOOD (3) | |
| 450, 450X. MEASUREMENT OF ABILITIES (3) | Mr. Ray |
| 482. INTRODUCTION TO CLINICAL PSYCHOLOGY (3) | Mr. Snyder |
| 500. SEMINAR: INTRODUCTION TO GRADUATE STUDY (0) For all new graduate students in psychology. | |
| | Mr. Carpenter |
| 501. ADVANCED PSYCHOLOGY (3) Comprehensive study of general psychology. Pre-requisite: 9 credits in psychology. | |
| | Mr. Lepley |

PSYCHOLOGY

502. ADVANCED EDUCATIONAL PSYCHOLOGY (2-4) Psychological theories and principles underlying educational theories and practices. Prerequisites: Psy. 14 or 414; Ed. 31 or teaching experience. *Messrs. Thevaos and Whaley*
503. PHYSIOLOGICAL PSYCHOLOGY (2-6) Correlations between structure and function of nervous system and human consciousness; laws and theories in fields of sensation, attention, association, affection, and thought. Prerequisite: 9 credits in psychology. *Mr. Slivinske*
504. COMPARATIVE PSYCHOLOGY (2-4) Behavior from standpoint of phylogenetic growth and development; biological implications; comparison of different types of animals, including man. Prerequisite: 9 credits in psychology. *Mr. Hale*
505. RESEARCH PROBLEMS IN PSYCHOLOGY (1-15) Prerequisite: 12 credits in psychology.
509. ADVANCED THEORY OF LEARNING AND HABIT FORMATION (2-3) Critical evaluation of major theories of learning: Hull, Guthrie, Tolman, Lewin. Application of learning theory to major problems in psychology. Prerequisite: Psy. 4 or 407 or 414. *Mr. Grosslight*
510. HISTORY OF PSYCHOLOGY (3) Theoretical systems, experiments, and personalities in development of modern psychology until about 1920. Prerequisite: 9 credits in psychology. *Mr. Carpenter*
511. CONTEMPORARY AMERICAN PSYCHOLOGY (2-3) Current systems or schools of psychology with comparative study and critical analysis; points of view as presented by recognized leaders. Prerequisite: 9 credits in psychology. *Mr. Hall*
513. EDUCATIONAL PSYCHOLOGY: DIFFERENTIAL (3) Causes of differences in achievement and personality; psychological implications of methods used by schools in adjusting to individual differences. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Mr. van Ormer*
514. EDUCATIONAL PSYCHOLOGY: LEARNING (2) Experimentally determined facts about the learning process; synthesis of main theories of learning; application of principles related to: motivation, practice, retention, transfer, meaning, and problem solving. Prerequisites: Psy. 14 or 414; 6 credits at 400 level in psychology. *Messrs. van Ormer and Thevaos*
515. ADVANCED STATISTICS IN PSYCHOLOGY AND EDUCATION (3) Correlation theory and methods, discriminant function, and factor analysis; applications to mental test theory. Prerequisite: Psy. 415 or Ed. 574. *Mr. Siegel*
517. PSYCHOLOGY OF ATTITUDES AND OPINIONS (3) Acquisition and control of attitudes and opinions, including beliefs, convictions, biases, prejudices, and ideologies as determinants of action. Prerequisite: 18 credits in psychology, including Psy. 417, 422, 437.
518. PROJECTS IN EXPERIMENTAL PSYCHOLOGY (2-4) Individual experimental projects; seminars on experimental design and instrumentation. Prerequisite: Psy. 407.
522. ADVANCED PSYCHOLOGICAL MARKETING RESEARCH TECHNIQUES (3) Questionnaire designs to test consumer reaction to products, advertising, and company policies from psychological standpoint. Prerequisite: 3 credits in statistics. *Mr. Guest*

525. SAMPLING DESIGNS IN MARKET AND OPINION RESEARCH (3) Techniques in selection of samples for accurate representation of human populations; special emphasis on probability sampling. Prerequisite: 3 credits in statistics. *Mr. Guest*
527. STATISTICAL INFERENCE AND EXPERIMENTAL DESIGN (3) Probability theory, sampling distributions, analysis of variance and covariance, analysis of trend, non-parametric statistics, experimental design. Prerequisite: Psy. 415 or Ed. 574. *Mr. Ray*
528. OPINION RESEARCH ADMINISTRATION (3-6) Practicum in planning, development of techniques, and administration of the sample survey. Prerequisites: Psy. 15, 21, 422. *Mr. Guest*
529. (C.D.F.R. 529). SEMINAR IN CHILD DEVELOPMENT (1-6) Readings and reports on recent findings in child development. Prerequisite: 6 credits in child development or 6 in educational or child psychology, plus 3 in statistics.
534. ADVANCED ENGINEERING PSYCHOLOGY (3) Experimental studies of psychological factors affecting design and operation of machines. Prerequisites: Psy. 3 and 4, or Psy. 432 or 501. *Mr. Corso*
- 535, 535X. HUMAN DEVELOPMENT (2-3) Psychological phases of human development throughout the life span; implications for school, community, and home. Prerequisite: 9 credits in psychology. *Messrs. van Ormer and Whaley*
536. RESEARCH METHODS AND PROBLEMS IN EDUCATIONAL AND DEVELOPMENTAL PSYCHOLOGY (1-6) Prerequisites: Psy. 414 or 514; Ed. 470 or Psy. 415.
537. SEMINAR IN INDUSTRIAL PSYCHOLOGY (3) Prerequisite: Psy. 431. *Mr. Smith*
538. PSYCHOLOGY OF PERSONNEL DEVELOPMENT (3) Industrial training in relation to psychological learning theory and experimental findings. Prerequisite: Psy. 431 or 414. *Mr. Smith*
539. MOTIVATION AND EMOTION (3) Systematic status of instinct, drive, motive, will, purpose; methodology and results of physiological, experimental, and clinical investigation of basic drives. Prerequisite: Psy. 503. *Mr. Hall*
540. CLINICAL PSYCHOLOGY SEMINAR (1-6) Seminar on current problems in clinical psychology. Prerequisite: Psy. 482.
541. DYNAMICS OF HUMAN ADJUSTMENT (3) Seminar on motivation of human behavior, frustration, and mechanisms of adjustment; normal behavior is stressed. Prerequisite: Psy. 437. *Mr. Gorlow*
542. PSYCHOPATHOLOGY (3) Covers basic, developmental, human, experimental reactions, showing how normal and pathological character trends and deviations evolve; basic reasons for and applications of psychotherapeutic methods. Prerequisite: Psy. 412 or 437. *Dr. Lott*
543. COUNSELING TECHNIQUES (2) Survey of psychotherapeutic methods; history, theory, and methods employed; case illustrations. Prerequisite: Psy. 482. *Mr. Snyder*
550. PSYCHOMETRICS: BINET (2) Measurement of intelligence by Stanford revision of the Binet-Simon technique; demonstrations, lectures; practice administering tests; observations of student by instructor. Prerequisite: Psy. 450.

PSYCHOLOGY

551. PSYCHOMETRICS: POINT SCALES (2) Measurement of intelligence by individual nonverbal techniques: Arthur, Wechsler-Bellevue, and others; demonstrations, lectures, and practice administering tests under observation. Prerequisite: Psy. 450.
552. PSYCHOMETRICS: PRESCHOOL (2) Measurement by individual preschool scales: Merrill-Palmer, Minnesota, California First Year; demonstrations, lectures, and practice in administering tests under observation. Prerequisite: Psy. 551.
553. PSYCHOMETRICS: ADVANCED (2) Measurement of intelligence, social maturity, and other characteristics; demonstration, lectures, and practice in administering tests; observations by instructor. Prerequisite: Psy. 550.
555. PSYCHOMETRICS: RORSCHACH ADMINISTRATION (3) Introduction to theory of projective tests; supervised practice in administering and scoring of the Rorschach test. Prerequisite: Psy. 550 or 551. *Messrs. Guthrie and Gorlow*
556. PSYCHOMETRICS: RORSCHACH INTERPRETATION (3) Study of current literature and supervised practice. Prerequisite: Psy. 555. *Messrs. Guthrie and Gorlow*
557. PSYCHOMETRICS: ADVANCED PROJECTIVE TECHNIQUES (2-3) Survey of common projective techniques other than the Rorschach, with supervised practice. Prerequisite: Psy. 556. *Messrs. Guthrie and Gorlow*
- *560. CLINICAL PRACTICUM (1-8) Applied experience in techniques of clinical psychology; case work in the Psychology Clinic. Prerequisites: Psy. 482, 550, 551.
561. CLINICAL PRACTICUM: ELEMENTARY SCHOOL (1-3) Experience in the Psychology Clinic and public schools in learning and adjustment problems; diagnosis and remedial work; pertinent school laws and practices. Prerequisites: Psy. 560 and Ed. 70, or Ed. 432g or 470.
562. CLINICAL PRACTICUM: VOCATIONAL GUIDANCE (1-3) Practical experience in the Psychology Clinic on high school, college, and adult vocational guidance cases; staff meetings; seminar on techniques and materials. Prerequisite: Psy. 560 or Ed. 502.
563. CLINICAL PRACTICUM: MARITAL COUNSELING (1-3) Experience in the Psychology Clinic on premarital and marital adjustment; seminar on techniques of adjustment and development of sexual and emotional maturity in marriage. Prerequisite: Psy. 560. *Mr. Adams*
- 564, 564X. CLINICAL PRACTICUM: PERSONAL ADJUSTMENT COUNSELING (2-3) Advanced practicum with experience in counseling of personal adjustment problems referred to the Psychology Clinic. Prerequisite: Psy. 565. *Mr. Snyder*
565. CLINICAL PRACTICUM: NONDIRECTIVE COUNSELING (3) Practical experience in application of the nondirective method, along with systematic theoretical study of the method. Prerequisites: Psy. 543, 560. *Mr. Snyder*
566. CLINICAL PRACTICUM: HYPNOTHERAPY (1-3) Practical experience in the Psychology Clinic in use of hypnotherapy; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.
567. CLINICAL PRACTICUM: PLAY THERAPY (1-3) Practical experience in the Psychology Clinic in use of play therapy with young children; staff meetings; seminar on principles and techniques. Prerequisites: Psy. 543, 560.

* Not more than 4 credits per semester.

568. **CLINICAL PRACTICUM: GROUP THERAPY (2)** Practical experience in the Psychology Clinic in use of group methods for treatment of personal maladjustment; staff meetings; seminar on principles and techniques. Prerequisite: Psy. 565.
Mr. Gorlow
569. **CLINICAL PRACTICUM: ADVANCED NONDIRECTIVE (2)** Practical experience in the Psychology Clinic in advanced nondirective therapy techniques; staff meetings; case conferences. Prerequisite: Psy. 565.
Mr. Snyder
570. **INTERNSHIP IN PROFESSIONAL PSYCHOLOGY (1-9)** Internship, under supervision of graduate faculty, in institution with practicing psychologists, where student is not regularly employed. Prerequisite: 3 semesters of graduate work in psychology.
Unit A. Comparative Psychology
Unit B. Educational and Developmental Psychology
Unit C. General Experimental Psychology
Unit D. Industrial and Business Psychology
Unit E. Social Psychology
Unit F. State Institutional Psychology
574. **MENTAL DEFICIENCY (3)** Causes of mental deficiency; diagnosis, training, and care of mental defectives. Prerequisite: Psy. 414 or 482.
580. **THEORY AND CONSTRUCTION OF ATTITUDE SCALES (3)** Measurement of social, political, commercial, and industrial attitudes; questionnaire designs. Prerequisite: 3 credits in statistics.
Mr. Guest
590. **SEMINAR: ADVANCED (1-2)** Prerequisite: Psy. 500.
591. **SEMINAR ON TEACHING PSYCHOLOGY (1-3)** Objectives and content of psychology; organization and presentation of material; teaching aids and techniques.
Mr. Whaley

RECREATION EDUCATION

FRED M. COOMBS, *in Charge of Recreation Education*
244 Recreation Building

Graduate work leading to the M.Ed., M.S., D.Ed., and Ph.D. degrees is offered. Students may prepare for recreation administrative positions in public recreation systems, industries, hospitals, camps, or private agencies; or for leadership of special groups in a particular activity. The areas for specialization include: (1) history, philosophy, and principles; (2) administration and supervision; (3) planning areas and facilities; (4) program content and application; (5) surveys and appraisals; (6) principles of the group process; and (7) research.

For admission an undergraduate major in recreation education is desirable; but a major in sociology, music, physical education, fine or industrial arts, theatre arts, or other related fields may be accepted.

The prerequisites for the M.Ed. program are 24 semester hours in professional recreation education and 24 in education and psychology, including general psychology, educational psychology, principles and methods of teaching, education electives, and practice teaching.

The prerequisites for the M.S. program are 18 semester hours in education and psychology and 36 in professional recreation education made up as follows: 12 cred-

RECREATION EDUCATION

its in professional recreation education, of which as many as 6 may be in physical education activity courses; 12 credits which shall include field work or practice teaching in recreation education with the additional credits from physical education, sociology, music, industrial arts, or theatre arts; 12 credits which shall include at least two of the following areas—arts and crafts, music, theatre arts, nature education, or camping.

Students who lack some of the prerequisite courses may be admitted but are required to make up the deficiency without degree credit.

RECREATION EDUCATION (RC ED)

430. CAMPING AND OUTDOOR EDUCATION (3)

432. RECREATION IN INDUSTRY (3)

434. RECREATION AREAS AND FACILITIES (3)

456, 456X. SOCIAL RECREATION (3)

461, 461X. COMMUNITY RECREATION (3)

462. RECREATION FOR THE HANDICAPPED (3)

465, 465X. ADMINISTRATION OF RECREATION (3)

530. CAMP ADMINISTRATION (3) Camp site development; staff selection, training, and supervision; development of objectives and program planning; values inherent in outdoor and camping education. Prerequisite: Rc.Ed. 430.

533. RECREATION STUDIES, SURVEYS, AND APPRAISALS (3) Types, purposes, and methods of conducting recreation studies and surveys; procedures in appraisal of community recreation. Prerequisite: Ph.Ed. 530.

560. ADMINISTRATIVE PROBLEMS OF RECREATION (3) Administrative problems in park and recreation departments; departmental organization, finance, personnel, facilities, program, and public relations. Prerequisite: Rc.Ed. 465.

ROMANCE LANGUAGES AND LITERATURES

FRANKLIN B. KRAUSS

Head of the Department of Romance Languages
301 Sparks Building

The master's degree and the doctorate are offered with a major in Romance languages and literatures. The minimum requirement for admission to an advanced degree program will normally be the basic 24 credits of the undergraduate major program at this University or the equivalent thereof.

FRENCH (FR)

400. FRENCH LITERATURE OF THE RENAISSANCE (3)

405. FRENCH LITERATURE IN THE ROMANTIC PERIOD (3)

406. FRENCH LITERATURE IN THE REALISTIC PERIOD (3)

411. FRENCH PROSE OF THE 20TH CENTURY (3)

413, 413X. CONTEMPORARY FRENCH DRAMA (3)

416. FRENCH POETRY AND DRAMA OF THE 20TH CENTURY (3)

421. THE TEACHING OF ROMANCE LANGUAGES (3)

431. FRENCH LITERATURE OF THE CLASSICAL PERIOD (3)

ROMANCE LANGUAGES AND LITERATURES

- 433. THE AGE OF ENLIGHTENMENT (3)
- 437. THE FRENCH ANALYTICAL NOVEL (3)
- 471. PROBLEMS IN FRENCH LITERATURE (3-6)
- 490. ADVANCED COMPOSITION AND CONVERSATION (3)
- 496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

*1G. ELEMENTARY FRENCH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.

- 501. FRENCH DRAMA OF THE CLASSICAL PERIOD (3) Origins and development of French classical comedy and tragedy, emphasizing the works of Corneille, Racine, and Molière.
- 549. SYMBOLISM (3) The anti-positivistic tradition in 19th century French literature dealing with the Symbolist School, its antecedents and its subsequent ramifications.
- 552. MEDIEVAL FRENCH LITERATURE (3) Familiarizes the student with Old and Middle French texts from the earliest monuments to Villon. Prerequisite: R.Ph. 551.
- 553. FRENCH LITERATURE OF THE RENAISSANCE (3) The French Renaissance from 1498 to 1548.
- 562. FRENCH THINKERS OF THE 18TH CENTURY (3)
- 564. FRENCH ROMANTICISM (3) The French Romantic movement after 1830.
- 570. VOLTAIRE AND ROUSSEAU (3)
- 571. SEMINAR IN FRENCH LITERATURE (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.
- 572. SEMINAR IN FRENCH LITERATURE (3) Continuation of Fr. 571.
- 580. PROUST AND GIDE (3)

ITALIAN (IT)

- 571. SEMINAR IN ITALIAN LITERATURE (3) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.

PORTUGUESE (PORT)

- 571. SEMINAR IN PORTUGUESE LITERATURE (3-6) Prerequisite: Port. 4.

SPANISH (SPAN)

- 401. THE GOLDEN AGE (3)
- 402. DRAMA OF THE GOLDEN AGE (3)
- 403. DON QUIXOTE (3)
- 404. OLD SPANISH LANGUAGE AND LITERATURE (3)
- 405. SPANISH DRAMA OF THE 19TH CENTURY (3)
- 406. CONTEMPORARY SPANISH DRAMA (3)

* No graduate credit is given for this course.

ROMANCE LANGUAGES AND LITERATURES

- 407. THE SPANISH NOVEL OF THE 19TH CENTURY (3)
- 408. THE CONTEMPORARY SPANISH NOVEL (3)
- 409, 409X. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)
- 410. INTRODUCTION TO LATIN-AMERICAN LITERATURE (3)
- 411. MEXICO: ITS LANGUAGE AND LITERATURE (3)
- 412. ARGENTINA: ITS LANGUAGE AND LITERATURE (3)
- 415. MODERN SPANISH LYRIC POETRY (3)
- 417. SPANISH LITERATURE IN THE ROMANTIC PERIOD (3)
- 421. THE TEACHING OF ROMANCE LANGUAGES (3)
- 471. PROBLEMS IN SPANISH LITERATURE (3-6)
- 490. ADVANCED COMPOSITION AND CONVERSATION (3)
- 496. LITERARY CRITICISM IN FRANCE, ITALY, AND SPAIN (3)

*1G. ELEMENTARY SPANISH FOR GRADUATE STUDENTS (3) Designed for students preparing to satisfy language requirements for advanced degrees.

- 501. GOLDEN AGE LITERATURE (3) Nature and development of Spanish literature of the 16th and 17th centuries.
- 538. THE GENERATION OF 1898 (3) Principal works and intellectual trends of the period with special emphasis on Unamuno.
- 549. MODERNISMO (3) The movement, its antecedents, and its followers, with special emphasis on Rubén Darío.
- 552. MEDIEVAL SPANISH LITERATURE (3) Familiarizes the student with Old Spanish texts.
- 561-562. SPANISH DRAMA PREVIOUS TO LOPE DE VEGA (3 each) Origin and early development of the Spanish national drama. Representative plays of different types will be read and discussed.
- 565. LOPE DE VEGA (3)
- 566. LOPE DE VEGA'S FOLLOWERS (3)
- 567-568. CERVANTES AND HIS WORKS (3 each)
- 571. SEMINAR IN SPANISH LITERATURE (3-12) Lectures on methods of research. Students will pursue common and individual investigations in fields selected after consultation with the instructor.
- 572. SEMINAR IN SPANISH LITERATURE (3) Continuation of Span. 571.

ROMANCE LITERATURE (R LIT)

- 544. NEOCLASSICISM IN THE ROMANCE LITERATURES (3) The neoclassical movement in the Romance literatures, with emphasis on French and Spanish.
- 545. ROMANTICISM IN THE ROMANCE LITERATURES (3) The Romantic movement in the Romance literatures, with emphasis on French and Spanish.
- 546. MEDIEVAL ROMANCE LITERATURES (3) Medieval writings in the Romance literatures, with emphasis on French and Spanish.
- 547. REALISM IN THE ROMANCE LITERATURES (3) The Realistic movement in the Romance literatures, with emphasis on French and Spanish.

* No graduate credit is given for this course.

ROMANCE LANGUAGES AND LITERATURES

554. THE RENAISSANCE IN THE ROMANCE LITERATURES (3) The effect of the Renaissance on the Romance literatures, with emphasis on French and Spanish.

ROMANCE PHILOLOGY (R PH)

551. ROMANCE PHILOLOGY (3)
558. ADVANCED LINGUISTICS AND PHONETICS OF THE ROMANCE LANGUAGES (3)
573. THEORY AND TECHNIQUES OF TEACHING THE ROMANCE LANGUAGES (1-2)
574. METHODS AND BIBLIOGRAPHY IN ROMANCE LANGUAGES AND LITERATURES (1-2)

RURAL SOCIOLOGY

MACKLIN E. JOHN

Head of the Department of Agricultural Economics and Rural Sociology
1 Weaver Hall

A graduate program leading to the M.S. or the Ph.D. degree is offered. The entering student in the master's program should have as prerequisites 3 credits in rural sociology, 3 credits in sociology, and 3 additional credits in either field. If he does not have these prerequisites, he may take them at this University during the early part of his master's program.

RURAL SOCIOLOGY (R SOC)

452. RURAL ORGANIZATION (3)
454. RURAL SOCIAL WELFARE (3)
456. RURAL STANDARDS OF LIVING (3)
459. RURAL SOCIAL PSYCHOLOGY (3)
551. RURAL SOCIOLOGY SEMINAR (1-6) Prerequisite: 6 credits in rural sociology, sociology, or psychology.
552. ADVANCED RURAL SOCIOLOGY (3) Structure and functioning of rural society.
553. SEMINAR IN RURAL SOCIOLOGICAL RESEARCH (1-6) Continuation of R.Soc. 552. Functioning of rural society; research dealing with the subject reviewed and evaluated.
554. ADVANCED RURAL SOCIAL WELFARE (3) Analysis of welfare techniques and their application to rural situations. Prerequisites: R.Soc. 11; Psy. 2 or R.Soc. 459.
555. THE RURAL CHURCH (3) The rural church as a social institution; its relation to the community; the church in "problem" areas; effects of population trends on the program of the rural church; use of case studies and surveys. Prerequisite: 6 credits in rural sociology, sociology, or psychology.
557. THE DEVELOPMENT OF THE RURAL COMMUNITY (3) Origin and evolution of the rural community under different geographic and cultural conditions. Prerequisites: R.Soc. 11 or Soc. 1; R.Soc. 452.
559. ADVANCED RURAL SOCIAL PSYCHOLOGY (3) Application of social psychological principles to treatment of rural problems. Prerequisites: R.Soc. 11, Psy. 2.

SOCIAL STUDIES

NEIL A. McNALL

Chairman of the Committee on Social Studies
115 Sparks Building

The M.Ed. degree is offered with a major in social studies. The program, which is designed to meet the needs of secondary school teachers, consists of at least 24 credits chosen from economics, history, human geography, political science, and sociology, and a minor of at least 6 credits in basic education. A candidate is expected to complete at least 3 credits in each of four fields and not more than 12 credits in one of them.

To undertake graduate work in this field, the student must have had solid preparation in the basic courses in history, political science, economics, and sociology; and he should have had some advanced undergraduate work in at least one of the fields named. He should be certified for teaching social studies, and ideally he should have had teaching experience in this field as well.

SOCIOLOGY

WILLIAM G. MATHER, *Head of the Department*
123 Sparks Building

Graduate work leading to the M.A. and Ph.D. degrees is offered in sociology. A minor may be taken in anthropology. Undergraduate preparation must include 12 hours in sociology and at least 7 in other social sciences, with a broad background in the arts and sciences preferred. Students of exceptional ability who are slightly deficient in undergraduate preparation may be accepted, on condition that they make up their deficiency in courses without degree credit.

SOCIOLOGY (SOC)

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| 401. SOCIAL INSTITUTIONS (3) | Mr. Green |
| 403. ADVANCED SOCIAL PSYCHOLOGY (3) | Mr. Coutu |
| 405S. SOCIAL PROBLEMS (3) | |
| 408. SOCIAL ECOLOGY (3) | |
| 413. METHODS AND TECHNIQUES OF SOCIAL RESEARCH (1-6) | Mrs. Bernard |
| 418. THE DEVELOPMENT OF SOCIAL THOUGHT (3) | |
| 423. POPULATION RESEARCH (3) | Mr. Clark |
| 424. SOCIAL CHANGE (3) | Mr. Abramson |
| 425. CONTEMPORARY SOCIOLOGICAL THEORY (3) | Mr. Green |
| 426. INTRODUCTION TO PUBLIC WELFARE (3) | Mr. Mather |
| 427S. FAMILY CASE WORK (6) | |
| 429. SOCIAL STRATIFICATION (3) | Mr. Abramson |
| 431. COMMUNICATION AND MASS SOCIETY (3) | Mr. Abramson |
| 470. USE OF STATISTICS IN SOCIOLOGY (3) | Mr. Clark |
| 495S. (C.D.F.R. 495S, Ed. 495S, Hl.Ed. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3) | |
| 499X. FOREIGN STUDY IN SOCIOLOGY (2-6) | |

500. SEMINAR IN GROUP THEORY (1-3) The group as a unit of social structure and action.
503. SEMINAR IN SOCIAL PSYCHOLOGY (3-9) Investigation of theories, methods, and empirical data of social psychology, with particular reference to such problems as relations between personality and culture, social and personal disorganization, development of role behavior, and conception of the self. *Mr. Coutu*
510. FIELD WORK IN SOCIOLOGY (1-6)
513. SEMINAR IN SOCIOLOGICAL RESEARCH PROBLEMS: A. RESEARCH TECHNIQUES; B. CURRENT RESEARCH (3-6) Prerequisites: Soc. 413; 3 credits in statistics. *Mr. John, Mrs. Bernard*
515. SEMINAR IN COMMUNITY STUDIES (3) *Mrs. Bernard*
516. SEMINAR IN SOCIOLOGICAL THEORY (3-9) *Messrs. Green and Blizzard*
523. POPULATION PROBLEMS (1-9) *Mr. Clark*
525. SEMINAR IN SOCIOLOGY (1-9) Research problems in theoretical and applied sociology.
530. RESEARCH ON MARRIAGE AND THE FAMILY (3) Training in methods and techniques of research in family relations. Experimental, statistical, and comparative studies are carried out, individually or co-operatively. Prerequisite: 3 credits of previous work in this field. *Mrs. Bernard*
572. METHODS OF SAMPLING (3) Application of sampling techniques to sociological research. *Mr. Clark*

SPEECH

ROBERT T. OLIVER, *Head of the Department*
300 Sparks Building

Graduate programs are offered which lead to the M.A., M.Ed., D.Ed., and Ph.D. degrees. The student may specialize in speech arts (interpretation, drama, theatre); radio and television; rhetoric and public address (including discussion, communication, teaching of speech); speech science (voice, diction, phonetics, general semantics); or speech pathology and audiology.

The minimum undergraduate preparation required is 12 credits in speech including Spch. 200, Effective Speech, and Spch. 320, Speech Science, or their equivalents. Students who cannot meet this requirement in full may be admitted but must make up their deficiencies without credit toward the graduate degree. If Spch. 401, Problems, Methods, and Areas in Speech, or an equivalent course at the graduate-undergraduate level, is not offered for admission, it will be required as a part of the graduate program.

SPEECH (SPCH)

- 400, 400X. TEACHING OF SPEECH (3) *Mr. Schug*
401. PROBLEMS, METHODS, AND AREAS IN SPEECH (3) *Mr. Carter*

SPEECH

402. INTRODUCTION TO GENERAL SEMANTICS (3) *Mr. Carter*
 410. ENGLISH PHONETICS AND PRONUNCIATION (3) *Mr. Brubaker*
 411a,b,cS. SPEECH SCIENCE AND SPEECH ARTS (1-3)
 412. SPEECH COMPOSITION (3) *Mr. DeBoer*
 415. EXPERIMENTAL AND APPLIED PHONETICS (3) *Mr. Brubaker*
 425. ADVANCED PRINCIPLES OF RADIO SPEECH (3)
 431. ANATOMY AND PHYSIOLOGY OF THE EAR AND VOCAL MECHANISMS (3) *Mr. Brubaker*
 435. RADIO ORGANIZATION (3) *Mr. Nelson*
 437. PRINCIPLES OF TELEVISION SPEECH (3) *Mr. Nelson*
 445. SPEECH AS A MEDIUM OF INTERNATIONAL RELATIONS (3) *Mr. Oliver*
 450. DISCUSSION TECHNIQUES (3) *Mr. Joseph O'Brien*
500. SEMINAR IN AMERICAN ORATORY (2-4) History of American oratory, with application of critical standards to the work of specific orators. Prerequisite: 6 credits in speech, including Spch. 200. *Mr. Joseph O'Brien*
505. HISTORICAL DEVELOPMENT OF SPEECH THEORY (2-4) Survey of ancient, medieval, and modern theories of public address in relation to currently accepted speech theories. *Mr. DeBoer*
508. SEMINAR IN BRITISH ORATORY (2-4) History of British oratory; application of critical standards to the work of selected orators. *Miss Fife*
510. SEMINAR IN METHODS OF TEACHING SPEECH (2-4) Curriculum construction, media, and methods in high school and college. Prerequisite: 6 credits in speech including Spch. 200. *Mr. Joseph O'Brien*
520. SEMINAR IN SPEECH SCIENCE (2-4) Seminar in physical and physiological bases of speech and voice; introduction to laboratory techniques used in speech research. Prerequisite: 9 credits in speech, speech education, or psychology. *Mr. Brubaker*
540. SEMINAR IN THE PROBLEMS OF RADIO (3) Advanced study and research in special problems in radio speech, radio production, and radio organization. Prerequisite: 6 credits in speech including Spch. 200, 300; 425 or 435. *Mr. Nelson*
550. SEMINAR IN ORAL PERSUASION (2-4) Theory and devices of persuasion; analysis of persuasive discourse. Prerequisite: 6 credits in speech including Spch. 200. *Mr. Oliver*
552. ORAL COMMUNICATION IN INDUSTRY, BUSINESS, AND GOVERNMENT (2-4) Needs, practices, and methods in American industry, business, and government; methods of training adults in oral communication skills. *Mr. Zelko*
555. SPEECH COMMUNICATION: PROBLEMS AND PRINCIPLES (2-4) Prevalent theories of speech influence. *Mr. Oliver*
560. PUBLIC ADDRESS (2-4) Discussion and criticism of speech outline, manuscript, content, composition, and delivery. Prerequisite: 6 credits in speech including Spch. 200. *Mr. Schug*
575. RESEARCH PROBLEMS IN SPEECH (1-12) Advanced research on an individual basis in oratorical criticism, discussion techniques, persuasion, pedagogy, phonetics, speech science, and speech pathology. Prerequisite: 12 credits in speech or in speech education.

STATISTICS

HENRY R. FORTMANN, *Chairman of the Committee on Statistics*
115 Tyson Hall

Statistics may be used as a field of study for a minor in an advanced degree program. This minor is intended to facilitate development of a coherent program of study in this vital branch of the scientific method.

An acceptable program should permit the candidate to become conversant with the broad field of statistics and to become reasonably proficient in the statistical methods particularly useful in the subject-matter areas of his major field. The member of the candidate's committee representing the minor in statistics will have responsibility and jurisdiction for determining course work acceptable in satisfying requirements for the minor in statistics.

The minimum requirements for a minor for a master's degree are 3 credits in mathematical statistics and 6 in applied statistics. For a doctor's degree a minimum of 15 credits in statistics is required for a minor, of which at least 6 must be mathematical statistics and at least 6 must be applied statistics.

Courses in mathematical statistics are: Math. 409, 410, 542, and 543.

Courses in applied statistics are: Ag. 400; A.B.Ch. 515; Ag.Ec. 505; Ag.Ed. 521v, 521vX; Agro. 512, 545; B.S. 500, 501; Econ. 480; Ed. 470, 574; I.E. 423; Meteo. 450; Min. 513, 514; Psy. 415, 515, 527; and Soc. 470, 572.

THEATRE ARTS

WALTER H. WALTERS, *Head of the Department*
201 Schwab Auditorium

The M.A. degree is offered with a major in theatre arts. Under certain circumstances the Ph.D. degree is offered by the Department of English Literature with specialization in drama and minor work in theatre arts.

A course in basic acting, one in directing, and one in theatre crafts, or their equivalents, are required for admission. In addition, the student must have had 12 credits divided between speech and the arts (including music, sculpture, painting, architecture, and other courses in which art is practiced); or a minimum of 9 credits in one of these; or a minimum of 9 credits in English and literature, including at least 6 in dramatic literature, or 3 in dramatic literature and 3 in advanced creative writing.

THEATRE ARTS (THEA)

- 403. ADVANCED MAKE-UP (1)
- 404. STYLES OF ACTING (3)
- 412. ADVANCED SCENE DESIGN (3)
- 413. STAGE LIGHTING (3)
- 421. ADVANCED PLAYWRITING (3)
- 431. HISTORY OF THE THEATRE (3)
- 442S. EDUCATIONAL DRAMATICS (3)
- 443S. EDUCATIONAL DRAMATICS (ADVANCED MARIONETTES) (3)
- 451. DIRECTING (3)

THEATRE ARTS

452. CENTRAL STAGING (3)
480. RADIO DRAMA (3)
481. ADVANCED RADIO DRAMA (3)
501. PROBLEMS OF DIRECTING (3-6) Seminar in problems of production with particular stress on direction. Students will direct plays under staff supervision.
502. SEMINAR IN THE TECHNICAL PROBLEMS OF DRAMATIC PRODUCTION (3-6) Prerequisite: Thea. 11.
504. SEMINAR IN STYLES OF ACTING (3-6) Practical work required of each student.
506. EVALUATION AND APPRECIATION OF MODERN DRAMATIC ENTERTAINMENT (3) Prerequisites: Thea. 1, 61.
507. SEMINAR IN FUNDAMENTAL THEORIES OF THEATRE AND DRAMA (3-6)
521. PLAYWRITING (3-6) Prerequisites: Thea. 21, 421.

WILDLIFE MANAGEMENT

Consult BERTIL G. ANDERSON
212 Frear Laboratories

The master's degree is offered in the field of wildlife management. Candidates select courses for this major from a number of related fields.

ZOOLOGY

BERTIL G. ANDERSON
Head of the Department of Zoology and Entomology
212 Frear Laboratories

The Department of Zoology and Entomology offers work leading to the M.S. degree with a major in zoology. Students may specialize in animal behavior, bioacoustics, ecology, endocrinology, fisheries biology, genetics, histology, ichthyology, invertebrate zoology, invertebrate physiology, or wildlife management.

In order to undertake graduate work in zoology, students are required to have had 24 credits in zoology and related biological sciences; and they should have had chemistry through organic chemistry. Courses in physics and mathematics are also advantageous. A limited deficiency can be made up without degree credit while pursuing graduate work.

ZOOLOGY (ZOOLOGY)

401. (P.H. 401, Psy. 401). ANIMAL BEHAVIOR (3)
405. (Bot. 405). GENERAL CYTOLOGY (3)
408. MAMMALOGY (4)
410. GENERAL LIMNOLOGY (3)
415. THE LITERATURE OF ZOOLOGY (1)

Mr. Hale
Mr. Grun
Mr. English

Mr. B. G. Anderson

416. THE METHODS OF RESEARCH IN ZOOLOGY (2) *Mr. B. G. Anderson*
417. INVERTEBRATE ZOOLOGY (3) *Mr. Frings*
- 418S. FIELD ORNITHOLOGY (3) *Mr. Wood*
419. GENERAL ANIMAL ECOLOGY (3) *Mr. Blackburn*
420. GAME BIRDS (3) *Mr. English*
421. COMPARATIVE ANATOMY OF VERTEBRATES (4)
422. (Bot. 422). ADVANCED GENETICS (3) *Mr. Wright*
432. HUMAN PARASITOLOGY (3) *Mr. Zelif*
- 433S. (Bot. 433S). GENETICS, EUGENICS, AND EVOLUTION (3)
436. PROTOZOOLOGY (3) *Mr. Zelif*
437. HISTOLOGY (4) *Mr. Anthony*
440. EMBRYOLOGY (4)
- 441S. ESSENTIALS OF HUMAN PHYSIOLOGY (3) *Mr. Tietz*
444. ZOOLOGICAL PROBLEMS (1-6)
448. ORNITHOLOGY (3) *Mr. Wood*
450. ICHTHYOLOGY (4)
461. ANIMAL PARASITOLOGY (3) *Mr. Zelif*
505. (Bot. 505). CYTOLOGY AND CYTOGENETICS (3) Chromosome mechanism of heredity; relationship between plant and animal evolution and breeding and changes in chromosomes; cytological and cytochemical techniques. Prerequisite: Bot. 22 or Zool. 22. *Mr. Grun*
508. ADVANCED PARASITOLOGY (3) Advanced work on the structure, life cycle, and control of parasites. Prerequisites: Ent. 2, Zool. 432. *Mr. Zelif*
509. TECHNIQUES IN WILDLIFE MANAGEMENT (3) Preparing study mounts, census making, management area mapping, methods of collecting data, and determining food habits from stomach contents. Prerequisite: Zool. 546. *Mr. English*
512. SEMINAR (1) Review of current zoological literature. Required of graduate students majoring in zoology and entomology. Prerequisite: 12 credits in zoology or entomology.
514. SPECIAL TOPICS IN ZOOLOGY (3) Individual problems in any field of zoology, with or without experimental work. Prerequisite: Zool. 26.
524. (Bot. 524). SEMINAR IN GENETICS (1 per semester) *Mr. Wright*
528. (Bot. 528). POPULATION GENETICS (3) Factors affecting gene frequency, genotype frequency, genotype-environmental interaction, and genetic relationship in natural and artificial populations. *Mr. Mitchell*
- 532S. ANIMAL PARASITES (3) Structure, life cycle, and control. Prerequisite: Zool. 432. *Mr. Zelif*
- 537S. (Bot. 537S, Ed. 537S). WORKSHOP IN THE BIOLOGICAL SCIENCES (3) Projects designed for teachers of biology in the secondary schools.
541. COMPARATIVE PHYSIOLOGY (3) Dynamics of vital processes as shown in members of the animal kingdom. Prerequisites: Zool. 26, A.B.Ch. 1, A.B.Ch. 425 or Zool. 437. *Mr. Frings*
546. THE THEORY OF GAME MANAGEMENT (4) Fundamental principles underlying management of wild game birds and mammals; co-ordination of such management

ZOOLOGY

with various land uses; planning preserves and other land areas. Prerequisites: Zool. 408, 420. *Mr. English*

547S. WILDLIFE MANAGEMENT (3) Basic principles concerned with management of game birds and game mammals. Prerequisite: Zool. 420. *Mr. English*

551. FISHERIES MANAGEMENT (3) Basic principles underlying management of inland waters for fish production. Prerequisite: Zool. 450.

581. ADVANCED INVERTEBRATE ZOOLOGY (3) Morphology, physiology, taxonomy, and life histories of invertebrate animals. *Mr. Frings*

583. GENERAL ENDOCRINOLOGY (2) Anatomy and physiology of the organs of internal secretion; role of hormones in metabolism and development. *Mr. Anthony*

587. BIOLOGY OF SEX (2) Hereditary and embryological aspects, problems in gonadal differentiation, cyclic reproductive phenomena, actions of the hormones. *Mr. Anthony*

Part II

Other Elective Graduate Courses

The following courses involve fields in which neither major nor minor work is offered at this institution. The courses, however, carry graduate credit and, with the approval of the major department, may be applied toward the requirements for a degree either as elective courses or as a part of a general studies program. The usual restrictions upon the use of 400 series courses in degree programs apply to these courses.

AGRICULTURE, GENERAL (AG)

400. INTRODUCTORY BIOMETRY (3)

ARCHAEOLOGY (ARCHY)

400-401. ARCHAEOLOGY OF THE NEAR EAST (3 each)
 402-403. ARCHAEOLOGY OF THE NEW WORLD (3 each)

Mr. Matson
Mr. Matson

ASTRONOMY (ASTRO)

430. GENERAL ASTRONOMY FOR TEACHERS (3)
 470. SOLAR PHYSICS (3)
 486. ASTRONOMICAL PHOTOGRAPHY (3)
 490-491. INTRODUCTION TO ASTROPHYSICS (3 each)

COMMERCIAL CONSUMER SERVICES (C C S)

403. LECTURE-DEMONSTRATION TECHNIQUES (3)
 450. PROBLEMS IN HOUSEHOLD EQUIPMENT (1-6)

Miss Allgood
Miss Allgood

ENGINEERING (ENGR)

410. NUCLEAR ENGINEERING (3)
 411. NUCLEAR ENGINEERING (3)
 422. ORDNANCE ENGINEERING: TORPEDO ENGINEERING (3)
 430. INTRODUCTION TO DIGITAL COMPUTER PROGRAMMING (1)
 431. DIGITAL COMPUTER PROGRAMMING (3)
 450. PATENT FUNDAMENTALS (3)

531. ADVANCED DIGITAL COMPUTER PROGRAMMING (3) Programming for commercial computers; programming techniques; numerical methods for computers; solution of problems on the Penn State Digital Computer. Prerequisites: Math. 405, Engr. 431.

GREEK (GREEK)

411S. ESSENTIALS OF GREEK (3)
 421. GREEK TRAGEDY (3)
 422. GREEK COMEDY (3)

Mr. Will
Mr. Will

GREEK

423. ATTIC ORATORS (3) *Mr. Will*
424. GREEK HISTORY OR PHILOSOPHY (3) *Mr. Will*
427. NEW TESTAMENT GREEK (3) *Mr. Will*
500. GREEK COMPOSITION (2) Translation of extended narrative passages into Attic Greek; thorough review of forms and syntax; attention to rhetorical elements of the language. *Mr. Will*

HEALTH EDUCATION (HL ED)

403. FIRST AID, ATHLETIC CONDITIONING AND TRAINING (3)
405. RECENT DEVELOPMENTS IN PUBLIC HEALTH EDUCATION (3-6)
406. RECENT DEVELOPMENTS IN SCHOOL HEALTH EDUCATION (3)
407, 407X. ADVANCED PERSONAL AND PUBLIC HEALTH (3)
411, 411X. PRINCIPLES AND METHODS OF TEACHING SAFETY EDUCATION (3)
427. HEALTH FACTORS IN THE DEVELOPMENT OF THE ADOLESCENT (3)
453, 453X. ORGANIZATION AND ADMINISTRATION OF HEALTH EDUCATION (3)
455S. RELATIONSHIPS OF HEALTH EDUCATION TO THE EXACT SCIENCES (3)
456. ADVANCED TECHNIQUES IN RURAL SCHOOL HEALTH (3)
495S. (C.D.F.R. 495S, Ed. 495S, Soc. 495S). FAMILY HEALTH AND HUMAN RELATIONS (3-9)
501. HEALTH IMPLICATIONS IN THE GROWTH AND DEVELOPMENT OF SCHOOL CHILDREN (3) Child growth and development emphasis for teachers; medical inspection and examination; preschool program; early habit formations; behavior problems; co-operation of parents, teachers, and children. Prerequisite: Hl.Ed. 215.
505. ADVANCED TECHNIQUES IN HEALTH EDUCATION (3) Prerequisites: Hl.Ed. 215, 399, Psy. 437.
572. TESTS AND MEASUREMENTS IN HEALTH EDUCATION (3) Critical study, evaluation, and demonstration of tests and measures of health education; statistical computations of data. Prerequisites: Ph.Ed. 490, Hl.Ed. 215, 399.

HOME-COMMUNITY RELATIONSHIPS (H C R)

- 499X. INTERCULTURAL STUDIES IN HOME ECONOMICS (2-6)
- 502, 502v, 502X, 502vX. HOME ECONOMICS AND AMERICAN SOCIETY (3) Family life education in relation to a democratic culture; emphasis upon the interrelatedness of socioeconomic problems and the American family.
503. GRADUATE SEMINAR IN HOME ECONOMICS (1) *Miss Henderson*

INTERNATIONAL UNDERSTANDING (INT U)

- 400S. WORLD AFFAIRS AND INTERNATIONAL UNDERSTANDING (3-6)

LATIN (LATIN)

428. LUCRETIVS (3) *Mr. Krauss*
429. QUINTILIAN (3) *Mr. Krauss*

431. JUVENAL (3) *Mr. Krauss*
- 436S. FUNCTIONAL PROBLEMS IN LATIN (3)
- 440a,b,c,dS. COLLEGE LATIN (3-12)
500. LATIN LITERATURE (3) Lectures and collateral readings on the major forms of Latin literature; readings in the original Latin to supplement the lectures. *Mr. Krauss*
501. ROMAN RELIGION AND PHILOSOPHY (3) Development of religious concepts at Rome from primitive Italic origins to the advanced forms that culminated in Roman Stoicism. *Mr. Krauss*
502. LATIN EPIGRAPHY (3) Lectures and readings on Roman inscriptions; illustrative exercises. *Mr. Krauss*
503. LATIN PALEOGRAPHY (3) The Latin alphabet, writing materials, Roman book and cursive hands; illustrative exercises. *Mr. Krauss*
504. ROMAN TOPOGRAPHY (3) Physical development of the city of Rome, its walls, aqueducts, bridges, streets, forums, public buildings, temples, etc.; building materials and methods of construction. *Mr. Krauss*
510. LATIN SEMINAR (3) *Mr. Krauss*
518. LATIN RESEARCH (1-3) Prosecution of an assigned problem under the guidance of a member of the department.

MINERAL INDUSTRIES (MN I)

400. MINERAL INDUSTRIES IN MODERN CIVILIZATION (3)

MINERAL SCIENCES (MN SC)

411. INSTRUMENT TECHNIQUES APPLIED TO MINERAL SCIENCE PROBLEMS (1-3)
Unit A. X-Ray Diffraction
Unit B. Electron Microscopy
Unit C. Spectroscopy
510. X-RAY AND ELECTRON DIFFRACTION ANALYSIS AS APPLIED TO MINERALS AND METALS (2) Prerequisite: Phys. 285. *Mr. Brindley*
520. ELECTRON MICROSCOPY IN MINERAL SCIENCE RESEARCH (1-4) Prerequisite: Mn.Sc. 411, Unit B. *Messrs. Bates and Comer*
530. SPECTROSCOPY IN MINERAL SCIENCE RESEARCH (1-4) Prerequisite: Mn.Sc. 411, Unit C. *Mr. Lovell*
540. SOLID STATE STRUCTURES AND REACTIONS IN MINERAL SYSTEMS (2-4) Crystal chemical approach to solid state reactions, sintering, melting, hardness, thermal expansion, and behavior of matter under high pressure. *Mr. Weyl*

PUBLIC UTILITIES (P U)

421. ELECTRIC UTILITIES (3)

R U S S I A N

RUSSIAN (RUS)

401. STUDIES IN RUSSIAN LITERATURE (3-6)

425. PUSHKIN (3)

426. DOSTOEVSKI (3)

427. TOLSTOY (3)

VETERINARY SCIENCE (V SC)

400. VETERINARY ANATOMY AND PHYSIOLOGY (3)

401. INFECTIOUS DISEASES OF DOMESTIC ANIMALS (2)

515. (Bact. 515). VIROLOGY (2-4) Rickettsial and viral agents parasitizing man, animals, and microorganisms. Prerequisite: Bact. 410.

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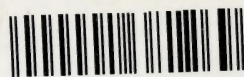
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